

NAVAL AIR WARFARE CENTER TRAINING SYSTEMS DIVISION

//



FY 17-18

RESEARCH COMPENDIUM

Training • Human Performance • Modeling & Simulation





NAWCTSD

Research Mission

- Plan and perform a full range of **research and development**, in support of **Naval training systems** for **all warfare areas** and **platforms**
- Continue to expand the **Naval technology base**
- **Transition results** to the **Fleet** and other customers



NAVAL AIR WARFARE CENTER TRAINING SYSTEMS DIVISION

(NAWCTSD)

FISCAL YEARS 2017 – 2018

RESEARCH COMPENDIUM

Training • Human Performance • Modeling & Simulation

Research & Development to Enable Fleet Success

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RESEARCH COMPENDIUM

NAVAL AIR WARFARE CENTER TRAINING SYSTEMS DIVISION | ORLANDO, FL

FISCAL YEARS 2017-18



The Naval Air Warfare Center Training Systems Division (Photo credit: Doug Schaub)

At the **Naval Air Warfare Center Training Systems Division (NAWCTSD)**, we are proud to be at the forefront of ground-breaking science and state-of-the-art technologies. This compendium provides a concise way for us to present the products of our Science and Technology (S & T) endeavors to you—our valued customers, colleagues, and industry and academia partners. This year’s “Research Compendium” has been streamlined—in terms of the presentation of the content and, where needed, the content, itself. It is our hope that you will find the updated content and new page layouts to be more conducive to your understanding of the information. Ultimately, we hope that the information you receive from reading this book will lead to more research ideas, new collaborations, and further development of our scientific and technological portfolio. Most importantly, let us never forget that what we do at NAWCTSD is...

...ALL FOR THE WARFIGHTER.

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A MESSAGE FROM OUR NAWCTSD LEADERS: SCIENCE & TECHNOLOGY TO ENABLE FLEET SUCCESS



Captain Erik O. Etz, USN
Commanding Officer



John Meyers
Technical Director

At NAWCTSD, we conduct research to understand and improve individual, team, and multi-team learning and performance. We develop education, training methods, and tools to reduce training time and maximize transfer of skills, utilizing emerging finds in the “Science of Learning” to enable Fleet success.

Our research focus areas align to our CORE CAPABILITIES:

1. Human Systems Engineering, Integration, and Acquisition
2. Optimized Human Performance and Decision Support
3. Advanced Training Systems Technology
4. Human Systems Analysis, Design, and Evaluation
5. Warfighter Protection, Performance, and Survivability

Within these five capabilities, near-term Fleet Science & Technology focus areas includes: distributed, Live, Virtual and Constructive (LVC) training; adaptive training; human performance modeling; measurement & assessment; virtual reality and augmented reality training technologies; cyberwarfare and electronic maneuver warfare training; and, rapid prototyping of training technologies.

Our research efforts focus on where the mission begins—where the body of knowledge of human performance and training is expanded, where innovations are developed, concepts are established, and prototypes are demonstrated.

We promote experimentation and creativity, and we encourage our people to challenge basic assumptions. We are open to reinventing ourselves based on new knowledge and understanding. To do this, we work to consistently seek Fleet input and feedback on our projects.

Our ultimate goal is that our training solution innovations are transitioned to the Fleet as quickly as possible to improve warfighter readiness. As part of this process, we lean forward to deliver Fleet prototypes for selected projects that show the greatest promise for transition and Fleet impact.

CHIEF TECHNOLOGY OFFICE



Dr. James Sheehy
Chief Technology Officer,
Naval Aviation Enterprise

"We continually strive to improve the way we plan and manage our S&T portfolio. Our S&T Objectives (STOs) are jointly developed with the Warfighters, technologists, requirements officers, and acquisition sponsors. Road-mapping of the individual STOs—coupled with our newly developed, department level, and bottoms-up Core Capabilities—play a major role in identifying gaps to guide and develop our investment strategies to clearly articulate our focus areas. These approaches are guided by a common process supported by quantitative metrics, with a goal of transitioning the best sustainable technologies at the lowest cost as quickly as possible to the Warfighter"

-- Dr. James Sheehy

The prime responsibility of the Naval Aviation Enterprise (NAE) Chief Technology Officer (CTO) is to ensure alignment, leveraging, and non-duplication of efforts—with focus on the NAE's current missions and future capability needs. This is done while balancing and managing a fiscally responsible S&T portfolio, which provides our warfighters with the technologies critical to their success.

Technology development is principally performed by the elements of the Naval Research Enterprise (Warfare Centers), industry, and academia which provide the critical technology and material that transition to the acquisition sponsors and ultimately the warfighter.

RESEARCH & TECHNOLOGY PROGRAMS OFFICE



Robert Seltzer
Director



Melissa Walwanis
Deputy Director



LCDR Rolanda Findlay
Military Deputy

NAWCTSD is a key warfare center laboratory for training systems and human performance. The primary goal of our researchers is to explore and develop advanced technologies and methodologies to ensure that the Fleet of tomorrow has the skills, training, and equipment it needs to enable success against current and future threats.

OUR VISION:

To merge behavioral, cognitive and engineering sciences to produce effective training solutions and systems, exploiting technology to improve performance, reduce risk, and reduce cost

OUR STRATEGY:

Partnering with and leveraging work at universities, industry, and other government laboratories, to provide advanced technologies that transition into operational use

***" We revitalize the workforce and enable technical excellence
through a focus on research and development."***

The Naval Air Warfare Center Training Systems Division (NAWCTSD) is the Navy's source for a full range of innovative products and services that provide complete training solutions. This includes research and development in human performance, learning, advanced technologies through training system acquisition and life cycle support.

NAWCTSD's research mission is to plan and perform a full range of directed Research and Development (R&D) in support of naval training systems for all warfare areas and platforms, to maintain an expanding naval-critical technology base, and to transition research results to the Fleet and other customers.

This publication annually reports the status of NAWCTSD's completing, active and new start Science and Technology (S&T) and Research and Development (R&D) Projects.

This year the publication has been revised to be organized by how the project aligns under one of the **five Human Systems Department Core Capabilities**. These five capabilities are:

- 1) Human Systems Engineering, Integration, and Acquisition
- 2) Optimized Human Performance and Decision Support
- 3) Advanced Training Systems Technology
- 4) Human Systems Analysis, Design, and Evaluation
- 5) Warfighter Protection, Performance, and Survivability

Then under each of these capabilities, they are organized from the Basic research category through the more advanced categories of research (e.g., Applied Research, Advanced Technology Development, etc.).

To provide some context, each project summary indicates in the footer what type of project it is. The project type consists of one of the following:

- Science & Technology Programs:
 - Discovery and Invention (D&I)
 - In-house Laboratory Independent Research (ILIR)
 - Independent Applied Research (IAR)
 - Section 219: Basic And Applied Research
 - Section 219: Technology Transition Research
 - Section 219: Strategic Growth
 - Advanced Technology Development
 - Capable Manpower Future Naval Capability Research
- Small Business Innovation Research (SBIR) and the Small Business Technology Transfer (STTR) programs
- Technology Transition Research
- Technology Transfer Program
- Capital Investment Program

Descriptions for each of these Sub-portfolio programs are described in the appendix.

RESEARCH & TECHNOLOGY PROGRAMS OFFICE

In July 2017, the new Chief of Naval Research, RADM Hahn, released the new guiding S&T document called, "A Framework for accelerating to the Navy & Marine Corps after Next". This document speaks to three guiding principles as follows: 1) Align early research early research, development and demonstration to priority technology requirements, 2) Allocate investments for higher pay off in lethality, integration and interoperability, and 3) Accelerate capability adoption to match the pace of technology innovation.

Overall all Navy Science and Technology (S&T) Strategy, developed by the Office of Naval Research (ONR), is designed to leverage advances in knowledge and technology under a Discovery and Invention (D&I) Program, and to demonstrate new technologies under a set of Future Naval Capabilities (FNC) Programs. Taken together, these programs comprise the Navy's technology base and support the vision of the Chief of Naval Operations.

Guidance comes from Integrated Product Teams that include representatives from the following: Requirements, Acquisition, S&T, and Fleet/Force communities. In collaboration with academic and industry partners, the Research and Technology Programs at NAWCTSD respond to research gaps working with ONR through such venues as the Capable Manpower FNC. They also address enabling capability gaps identified in the NAE Core Capabilities and Future Directions document developed by NAVAIR Chief Technology Office.

We pursue early advances in selected research areas under the D&I portion of the Navy S&T Strategy, with Basic Research and Applied Research as the primary components.

We also are involved in Transition Research to refine and evaluate technologies, and deliver them directly to the acquisition community or operational forces. Under the Section 219 Program, we are also able to fund critical work across the S&T budget activity levels using in-house funding. This program exists to help DoD laboratories build expertise and capabilities needed to meet current and future fleet stakeholder requirements, in parallel with the DoD policy for defense contractor-funded Independent Research and Development.

Another portion of our portfolio is aimed at accelerating the transition of technologies, with industry help, through such programs as the Small Business Innovation Research (SBIR) and the Small Business Technology Transfer (STTR) programs.

Additional efforts include cooperative and collaborative research with other government agencies, non-profit institutions, and commercial firms. Much of this work is done under the federally mandated Technology Transfer Program, in which capabilities developed with federal R&D funding are adapted to public and private needs. The scientists and engineers at NAWCTSD work closely together to develop and promote transitions of promising technologies.

The last section of the publication highlights the significant accomplishments of NAWCTSD's Science, Technology, Engineering and Math (STEM) Program. This workforce development program is critical to developing and maintaining the technical workforce talent of tomorrow needed by the Navy to sustain the health and vitality of the Naval Research Enterprise.



SUMMARIES OF RESEARCH PROJECTS

Photo credit – navy.mil

CORE CAPABILITY 1: HUMAN SYSTEMS ENGINEERING, INTEGRATION, AND ACQUISITION



The successful acquisition of training and crew system solutions is highly dependent upon the tailored application of Human Factors, Systems Engineering, and Human Systems Integration (HSI) strategies and processes throughout the acquisition life-cycle. The Department of Defense's (DoD) acquisition policy goal is to optimize total system performance while minimizing the cost of ownership through the development and acquisition management by applying HSI elements to acquisition systems.

HSI establishes the technical framework for delivering crew and training system capabilities to the warfighter. It ensures the effective development and delivery of capabilities through the implementation of a balanced approach with respect to cost, schedule, performance, and risk using integrated, disciplined, and consistent systems engineering activities and processes throughout the acquisition life-cycle to guide knowledge-based product development that demonstrates high levels of performance, protection, and sustainment before significant commitments are made.

The following Technology area comprises this Core Capability: Research, Design and Development of Integrated Human System products.

A HYBRID CLASSIFICATION APPROACH USING DOWN-SAMPLING TECHNIQUES AND TUNED HYPERPARAMETERS ON IMBALANCED DATASETS

PROJECT DURATION

NEW START
OCT 2017 - SEP 2018

OBJECTIVE

The objective of this study is to investigate multiple sampling techniques and hyperparameter settings for a set of machine learning algorithms (MLA) across an imbalanced dataset, specifically for the F/A-18 Environment Control System (ECS)-related memory unit data. This study will develop a model by using down-sampling techniques and tuned hyperparameters on imbalanced sets that yields a high predictive power of Physiological Events (PE).

VALUE TO THE WARFIGHTER

This research will provide new knowledge and technique on how to best utilize advanced machine learning to solve critical, real world big data problems such as those facing the Navy's aviation fleet in readiness and training.

FUNDING SPONSOR

Naval Air Systems Command
(NAVAIR) | Section 219

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An F/A-18E Super Hornet, left, from the Argonauts of Strike Fighter Squadron (VFA) 147, and a F/A-18F Super Hornet from the Black Knights of VFA-154 fly in formation past the U.S. 6th Fleet flagship USS Mount Whitney (LCC 20).

DESCRIPTION

The field of machine learning continues to grow and show promising capabilities, however, there are still some shortcomings that need to be addressed. One of the most pressing shortcomings of applying Machine Learning Algorithms (MLA) to real world problems is the lack of performance on imbalanced data sets. While research has shown that sampling techniques and tuning the hyperparameters of MLAs can improve their performance, there still remains a gap in the literature on whether the bias of the majority class can be overcome. This research shall test the hypothesis that a hybrid approach would best reduce the inherent bias of the majority class while conserving its intrinsic information.

NEED

There are current problems in the fleet, such as the incidence of PEs within NAVY F/A-18 platforms and the T-45 which have not been solved and are actively impacting fleet readiness. Effective analysis of imbalanced data sets could have immediate impact on these problems. Most real-life problems are always imbalanced in their data. Therefore, it

is imperative that methods of imbalanced dataset analysis be investigated to further understand how to best mitigate the majority class bias without losing too much from the majority class.

BENEFITS

The results of this study will contribute immediately to NAVY F/A-18 PE analysis. PE occurrences are a minority class in the population of all flights. Therefore, advancements in techniques for analyzing imbalanced datasets would benefit the analysis of PE-related data and enable analysts to better understand the differences between these flights and normal flights. The knowledge obtained from imbalanced datasets can also be applied to future Navy training solutions to improve training effectiveness. Furthermore, as the reliance on data within the NAVY increases better approaches and techniques will be of high importance in order to extract the necessary information to accurately inform management of what the data is saying.

STATUS

Two hypothesis shall be tested this year: 1) 'The combination of down-sampling and hyperparameter tuning will yield better predictive results than solely applying down-sampling techniques or solely modifying hyperparameters', and 2) 'The best combination of down-sampling technique and hyperparameters settings obtained from the generated dataset will also perform equally as well on the actual F/A-18 Flight Data'. Results shall be documented in reports that include sampling techniques of imbalanced datasets, tuning of MLAs, and the hybrid application of sampling techniques and hyperparameter tuning.

GOALS FOR FY18

- Planned products include:
 - Technical Report of research findings
 - Algorithm development that may result in novel solution eligible for patent consideration

DEPLOYING MOBILE DEVICES FOR NAVY TRAINING: LOW-COST MOBILE DEVICE MANAGEMENT ALTERNATIVES



The NAWCTSD Modern Learning Strategies (MLS) team helps organizations implement modern technologies for learning by operating within the union of the disciplines shown above. This project will expand NAWCTSD/MLS workforce knowledge, technical expertise, and smart buyer awareness in the field of Mobile Device Management (MDM) - a critical technology for adopting and promulgating mobile devices throughout Navy training.

DESCRIPTION

NAWCTSD engineers believe that by applying new technical capabilities (such as scoping mobile device management features to reduce complexity, and devising compensating controls to meet Cybersecurity mandates), the per student cost to provide mobile devices in Navy classrooms can be reduced to an amount comparable to the cost of printing paper-based curriculum. Achieving this cost would allow immediate fielding of tablets to schoolhouses using currently allocated budgets and available funds, and the lessons learned will facilitate wider adoption and availability of mobile technologies for training and data visualization across the Navy.

NEED

NAWCTSD engineers participating on Integrated Product Teams (IPTs) where mobile technology is being considered do not currently have the requisite knowledge to accurately assess level-of-effort or recommend cost-saving technology alternatives.

BENEFITS

Fielding tablets on a Navy network using Government-owned technologies in a manner that is reproducible, and then proving its efficacy in the Navy schoolhouse environment, opens the door to rapid adoption of tablet technologies for training applications across the Navy. Potential areas of applicability include: autonomy, UAS / Counter UAS training, big data representation for maintenance decision making, wider application of Ready Relevant Learning principles, etc.

STATUS

This is a FY18 new start. The knowledge gained in this effort will be documented in an Actionable Roadmap that will directly inform a follow-on software acquisition or in-house development effort (as appropriate based on the lessons learned through this project) to obtain and certify a Mobile Device Management and/or Mobile Application Management framework for Navy schoolhouses, with the goal of making the technology available to training initiatives across the Navy.

GOALS FOR FY18

- Through the research required to perform this effort, the participating workforce members will gain experience in the areas of Mobile Device Management and associated Cybersecurity policies related to connecting and certifying mobile devices on Navy computer networks.
- The deliverables that will be produced to document and capture this knowledge gain are:
 - Commercial-Off-The-Shelf (COTS) Mobile Device Management (MDM) feature priority list
 - Risk Management Framework (RMF) controls and compensating controls list
 - Actionable Roadmap
 - Proof-of-concept software source code and associated documentation that may inform NAWCTSD IPTs performing future acquisition/development efforts.

PROJECT DURATION

★NEW START★
OCT 2017 - SEP 2018

OBJECTIVE

Gain detailed technical expertise to develop NAWCTSD smart buyer awareness in the field of Mobile Device Management (MDM) - a critical technology for adopting and promulgating mobile devices throughout Navy training. Perform a case study to determine the minimum technical characteristics required of an MDM that would allow Navy schoolhouses to fully incorporate low-cost mobile devices into military training classrooms while adhering to DoD and DoN Cybersecurity mandates.

VALUE TO THE WARFIGHTER

This effort will equip NAWCTSD engineers and acquisition professionals with first-hand knowledge and an organic capability to respond with "speed to the fleet" when faced with emerging mobile requirements. The knowledge gained and Actionable Roadmap will be promulgated across NAWCTSD IPTs who have been tasked with large scale implementation and fielding of mobile devices at training sites.

FUNDING SPONSOR

Naval Air Systems Command
(NAVAIR) | Section 219

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SIMULATION STANDARDS FOR INTEROPERABILITY OF HUMAN PERFORMANCE AND DEBRIEF DATA IN TRAINING

PROJECT DURATION

★ NEW START ★

OCT 2017 - SEP 2019

OBJECTIVE

This project aims to provide a multi-disciplinary team with a Navy Standards and Human-in-the-loop voice in the process of developing an overall standard that Navy, Joint, coalition partners, and industry will comply with to enable training systems across the spectrum to be interoperable. This participation in Simulation Interoperability Standards Organization (SISO) Product Development Groups (PDG) will focus on development of standards associated with human performance and distributed debriefing.

VALUE TO THE WARFIGHTER

Ultimately, this project will ensure interoperability between systems, allowing for easier and more efficient training of the warfighter in integrated training systems. Implementing standards that ensure that the right data for quantitative data analyses and data science to understand proficiency are supported will ensure better fleet readiness and performance.

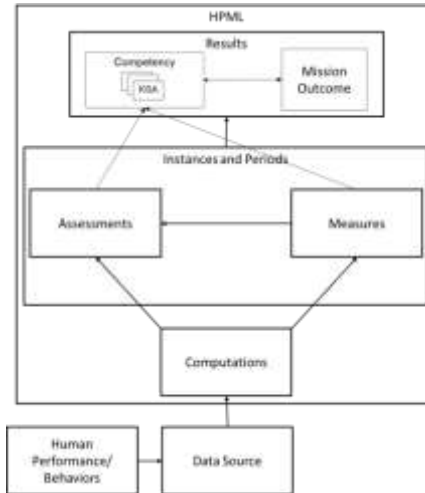
FUNDING SPONSOR

Naval Air Systems Command
(NAVAIR) | Section 219

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The Human Performance Markup Language (HPML) standard provides schemas for organizing information relevant to performance including: Computations, Measures, Assessments, Results, and Instances and Periods.

DESCRIPTION

Product Development Groups (PDGs) are collaborative opportunities for organizations (e.g., Department of Defense, North Atlantic Treaty Organization, industry, academia) to build consensus among members and refine standards that result in formal adoption by the Simulation Interoperability Standards Organization (SISO). This effort seeks to provide resources for a multi-disciplinary team of engineers and human factors professionals to actively participate in the Human Performance Markup Language (HPML) and Distributed Debrief Control Architecture (DDCA) PDGs.

NEED

Developers are currently challenged with finding ways to implement technology in environments that lack the right type of data. The technology challenge that exists is defining a means for implementing performance measures and an architecture for debriefing that increases their successful integration, and ensuring that Navy requirements are articulated and advocated for, during the industry standards development process.

BENEFITS

Interoperability is essential to supporting training in an integrated, interactive environment. Early participation in standards development ensures that the Navy's requirements are represented and that we maintain awareness of novel developments by other SISO members that may benefit our Science and Technology, Research and Development, and/or acquisition. Further, calls for quantitative data and big data analytics to understand proficiency requires access to the right data. Therefore, it is imperative to ensure that distributed training environments support assessment of performance and provides an architecture that facilitates distributed debriefs.

STATUS

This effort was selected for award as a FY18 new start. Teammates are reviewing the status of current PDG products, and plans to participate in the 2017 Simulation Innovation Workshop that has been scheduled for January 2018. Paper was accepted and will be presented at the 2017 Interservice/Industry Training, Simulation and Education Conference.

GOALS FOR FY18

- A Navy focused technical report will be delivered that summarizes the activities of the PDGs, implications for Navy Science and Technology, Research and Development, and/or acquisition.
- Mentor to other NAWCTSD competencies on the existence and importance of interoperability standards.

CORE CAPABILITY 2: OPTIMIZED HUMAN PERFORMANCE AND DECISION SUPPORT



Current and future Naval systems are not only dependent on the qualities of the systems and the performance of their operators, but are also highly dependent upon the interaction between the human and the system. Failure to effectively integrate the human and the system invites mission failure. It is routinely reported that 70-80% of all aviation and other mishaps trace back to human error in some fashion.

The overwhelming majority of these errors are related to inaccurate decisions, judgments, and perceptions, attributable to inadequacies in the systems design or decision-support capabilities. The extent to which those same design and/or decision support inadequacies contribute to operational inefficiencies or outright decrements is not as clearly quantified, but is expected to be profound.

Human Performance refers to the range of perceptions, decisions, and actions that an individual or team carries out in the context of performing a task. The underlying detail in each of these actions traces back to the design of systems and the training of operators. Human Performance Assessment (HPA) focuses on the ability to accurately measure and analyze task performance at different levels which include individuals, teams, multi-teams, and organizations. HPA can be conducted across multiple domains and tasks, ranging from simple procedural skills to complex cognitive skills, such as tactical decision-making, and is an integral part of Human Performance Modeling (HPM). Measurement technologies encompass neurocognitive, as well as other physiological measures or indices. Better understanding of such measures in the context of training or operational tasks will serve both to expand this technical area and to enhance warfighter performance and effectiveness.

Continued on next page

CORE CAPABILITY 2: OPTIMIZED HUMAN PERFORMANCE AND DECISION SUPPORT

Continued from previous page

While there is already a clear adverse impact resulting from the lack of / flawed human systems design and decision support, there is also a significant concern that this will be rapidly exacerbated due to the overwhelming amount of data being collected and available in a timely fashion. For human decision-makers to be effective in these information-rich environments, “they must be able to access the data necessary to make a decision when, where and in a manner that addresses the need. The data must be integrated and organized so that they become useful information to the user” (Morrison et al., 1998, p. 375). The challenge of integrating the human and system can be parsed into four separate pieces: 1) human factors engineering—which is required for the system to be used effectively by the human operator, 2) HMIs specifically developed to supplement the human’s ability to process, infer, and decide in real time actions based on system-provided information, 3) developing the requisite training materials of modes of presentation to optimally use the information to make and implement better, faster decisions, and 4) automation to perform functions without direct human intercession.

The following Technology areas comprise this Core Capability:

- Human-Machine Interfaces
- Human Performance Measurement and Assessment
- Training Methodologies for Distributed Team Competencies
- Advanced Instructional Techniques
- Applied Human Behavior Modeling

ADAPTIVE TRAINING SYSTEM FOR MAINTAINING ATTENTION DURING UNMANNED AERIAL SYSTEMS (UAS) OPERATIONS



The MQ-4C Triton unmanned aircraft system prepares to land at Naval Air Station Patuxent River, Md., after completing an approximately 11-hour flight from Northrop Grumman's California facility. (U.S. Navy photo by Kelly Schindler/Released)

DESCRIPTION

With the expanding use of UAS comes the increasing need for UAS operators to maintain attention for long periods of time during the missions. Shifts of up to 12 hours in length are not uncommon. Shiftwork is associated with higher fatigue levels, degraded task performance, and higher error rates. While existing UAS simulations aim to train operators on job-related skills, there are no systems currently that focus on attention. This research aims to develop tailored adaptive training techniques to minimize the issue of channelized attention. Training techniques capable of presenting long term mission requirements also need to be developed, as no such technology currently exists.

NEED

Channelized attention occurs when all of an individual's cognitive resources are focused on one aspect of the environment, causing other equally important cues to be missed. Investigations of larger group 4 and 5 UAS mishaps have indicated that issues with channelized attention contributed to the mishap(s). Thus, it is critical to provide training for UAS operators on how to maintain attention over extended periods of time.

BENEFITS

Research on attentional training has indicated that it is possible to train attention and create effects that transfer to tasks after training. Moreover, attentional training may be more effective if it is adaptive. Adaptive training is broadly defined as any instruction that is tailored to an individual trainee's strengths and weaknesses, so that the training experience varies from one individual to another based on task performance, aptitudes, or test scores.

The goal of adaptive training solutions is to provide the effectiveness of one-on-one tutoring through computer-based training that does not require an instructor in the loop. Thus, such training can possibly reduce the likelihood of UAS mishaps via a cost-effective method.

STATUS

The effort is currently in the Option period of Phase I, with a gated approach taking place to make a down-select from 2 companies to 1 prior to the Base period of Phase II. In Phase II, the selected company should finalize the adaptive training proof of concept with the candidate UAS mission requirements within the computer-based simulation. Individual test subject baselines should also be developed. Finally, post-training, an effectiveness evaluation (to demonstrate the improved attention of UAS operators) should be performed.

PROJECT DURATION OCT 2016 - SEP 2019

OBJECTIVE

The purpose of this effort is to develop an innovative and adaptive training system for Unmanned Aerial Systems (UAS) operators to maintain attentiveness during the long shiftwork associated with extended UAS missions. Cost-effective, computer-based simulation training solutions that are able to adapt to the 1) learning characteristics of different individuals, 2) affordances inherent in UAS, and 3) specific details involved with different missions were sought.

VALUE TO THE WARFIGHTER

This effort will result in the development of adaptive training techniques and a computer-based simulation trainer that apply specifically to the UAS domain to aid and improve attention during long mission requirements. Pre-training and post-training evaluations will measure the degree of improvement in attention of UAS operators.

FUNDING SPONSOR

Naval Air Systems Command
(NAVAIR)

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KEY ACCOMPLISHMENTS

- Selected 4 companies from more than 25 to perform during the Phase I Base Period
- Companies completed Base period of Phase I, in which they designed, developed, and demonstrated a proof of concept for adaptive training techniques and a computer based simulation trainer to improve operator attentiveness during long shift work
- Selected 2 of the 4 companies for gated approach to Phase II Base

DECISION-MAKING FOR HUMAN-MACHINE COLLABORATION IN COMPLEX ENVIRONMENTS

PROJECT DURATION

JUN 2014 - SEP 2017

OBJECTIVE

The objective of this ONR-sponsored research program is to investigate how Unmanned Aerial Vehicle (UAV) Sensor Operators (SOs) effectively integrate large amounts of disparate data into a manageable format that supports quick synthesis & transformation into actionable information that supports operator decision making in complex environments.

VALUE TO THE WARFIGHTER

The results from the series of Warfighter-centric experiments will provide design guidelines that (a) directly impact operator's ability to make optimal decisions based on automated tasking, (b) contact-identification search priority aid, and (c) redesign of displays for data presentation. These guidelines have the potential to create systems that optimize workload, thus improving performance.

FUNDING SPONSOR

Office of Naval Research (ONR)

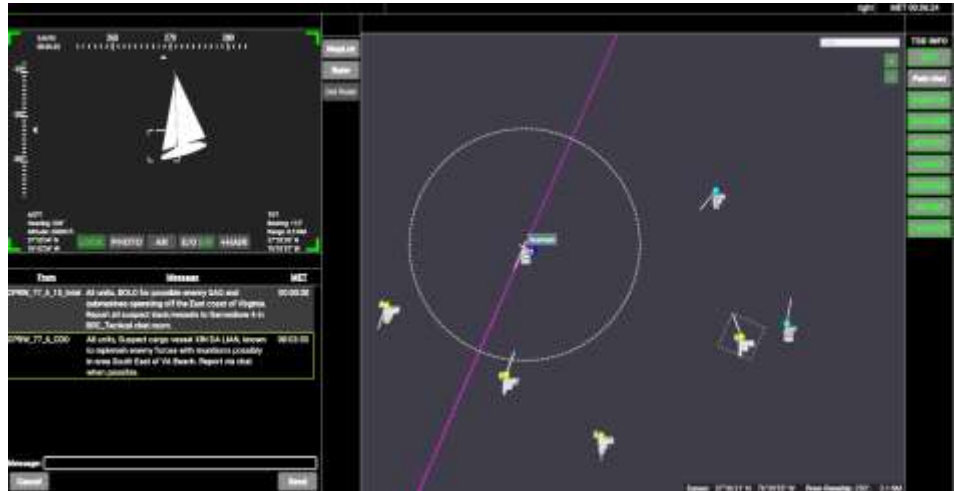
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Screenshot of the prototype web application developed in the course of this project

DESCRIPTION

This project is comprised of three studies conducted by performers from NAWCTSD, NAWCWD, NAWCAD, and contractors. The goal is to provide Unmanned Aerial System (UAS) design guidance that enables non-expert Sensor Operators (SOs) to perform similarly to experts by using a machine-learning algorithm (MLA). Study 1 was to evaluate the performance differences between expert and novice SOs (FY16). Study 2 is to investigate if novice decision making (DM) can increase with the use of a contact-identification priority aid and a MLA that simulates expert DM with data integration and automation capabilities (FY18). Study 3 will be to test the usability and effectiveness of UAS display redesign (FY19).

NEED

An Unmanned Aerial System (UAS) Sensor Operator (SO) is tasked with attending to many disparate sources of information. While previous research has identified effective sensor combinations for various platforms, the most effective way to translate this myriad of sensor data sources into actionable operator

information remains a critical area of research for UAS team performance.

BENEFITS

High cognitive workload has been shown to extend decision timelines and increase operator error. This effort will directly support the capability to investigate interface design and decision support methodologies to reduce operator workload and increase operator efficiency. The results can lead to future UAS display redesign guidelines intended to improve operator decision effectiveness and reduce workload in data-rich environments (e.g., UAS Ground Control Station).

STATUS

The first of three experiments was completed in Q2FY16 which investigated decision making inputs (i.e., cues) and techniques. The results of the study were published as presentations at two Human Factors conferences. These data were also used to determine which features should be included in the machine learning algorithm to support novice decision making that replicates that of experts for Study 2. The researchers are currently in preparation to conduct the follow-up experiment in Q1FY18.

KEY ACCOMPLISHMENTS

- Study 2 Accomplishments:
 - Established a remote connection between the NAWCAD Awesim Lab and NAWCTSD SubRat Lab
 - Programmed three computer-based experimental scenarios that were developed with the input of UAS SME's
 - Completed the Study 2 experimental protocol that will be submitted for IRB
 - Finalized and tested the machine-learning algorithm that leverages the expert decision making results from Study 1.
 - Achieved the contact search priority coding that highlights critical contacts to identify within the experimental scenarios.
- Professional Presentations:
 - Zemen, B., Postlewait, A., and Pagan, J. (2017). *Decision making support for human machine collaboration in complex environments: Determining decision making support requirements*. Presentation to be given at the 8th International Conference on Applied Human Factors and Ergonomics, Los Angeles, CA.

IDENTIFICATION AND DEFINITION OF UNMANNED AERIAL SYSTEM (UAS) AIR VEHICLE OPERATOR (AVO) PERFORMANCE METRICS



Chief of Naval Operations (CNO) Adm. John Richardson views the MQ-4C Triton unmanned aircraft system at Naval Air Station Patuxent River.

DESCRIPTION

The UAS AVO project aimed to identify measurable components and build an initial set of observer-based performance metrics through review of task analyses, focus groups with subject matter experts, and observation of training events. After development of the measurement tool, field testing will be conducted to assess reliability and validity.

NEED

Observer ratings of performance are commonplace in military aviation due to their benefits; however, there are significant drawbacks such as potential subjectivity or low reliability of assessment between different instructors. Given these risks, it is critical that we develop appropriate measures that address higher order skills.

BENEFITS

The development of performance metrics will facilitate consistency between instructors, increase feedback, and provides an assessment tool, all of which will increase the effectiveness and efficiency of UAS AVOs. The development and usage of performance

metrics will also ultimately inform selection techniques, which will save money and time in training and selection. Selection techniques can be developed from usage and analyses of performance metrics, and will allow trainees with innate aptitude to be selected for a certain role (e.g., AVO) which will decrease the amount of training time needed, and increase the value and skill received from training.

STATUS

The project team worked, redesigned, and finalized the objective observer performance metrics (OOPMs) using subject matter expert and end user feedback from the MQ-4C Triton Drone Training facility at Naval Air Station Jacksonville. The OOPMs were also expanded to have utility as both a performance measurement tool and as a tool for providing standardized instructor feedback. A usability study on the OOPMs was conducted. Project deliverables, which include the validated OOPMs and a performance measure development guide, have been provided to the VP-30 Triton Unmanned Aerial Vehicle Community.

PROJECT DURATION

OCT 2014 - SEPT 2017

OBJECTIVE

The current project seeks to identify, develop, validate, and transition UAS Air Vehicle Operator (AVO) observer performance metrics to support the validation of selection and training technologies.

VALUE TO THE WARFIGHTER

The UAS AVO project develops performance metrics in order to assess trainees' level of competence in certain areas. This facilitates greater consistency between instructors' ratings of trainees, increases the level of detail of feedback provided to trainees in more complex mission sets, and provides an assessment tool useful for 'capstone' type training events.

FUNDING SPONSOR

Naval Air Systems Command
(NAVAIR) | Section 219

POINT OF CONTACT

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KEY ACCOMPLISHMENTS

- Manuscripts/Publications: In preparation: T. Foster, R. Findlay, (2017, January 01). Summary of UAS AVO Performance Metrics Development.
- Awards: Receipt of award (Women of Color STEM Technology Rising Star)
- Presentations: Presentations at Aerospace Medical Association Conference (MAY 2015, APR 2016) and United States Naval Aeromedical Conference (JAN 2016)
- Workforce Development: Naval Research Enterprise Internship Program (NREIP) intern involvement with iterative development of objective observer performance metrics
 - NREIP Intern. E. Anania, (2017, June 05 - 2017, August 11). Embry Riddle Aeronautical University.
 - Mentor junior teammates on Navy training; provide opportunities for observations with Triton Fleet Introduction Team at NAS Jacksonville, VP-30.
- Transitions: Objective observer performance metrics tool delivered to Triton Fleet Introduction Team at NAS Jacksonville, VP-30; deployed for preliminary validation and utility analysis.

IMPACT OF LOW-COST HAPTIC CUEING ON USER PERFORMANCE AND WORKLOAD

PROJECT DURATION

NOV 2013 - DEC 2016

OBJECTIVE

To determine the impact of low-cost haptic cueing on operator performance and mental workload in a multitasking environment. Research has shifted to investigate the effects of cueing to aid visual search, specifically haptic cueing. However, its effects on performance accuracy and cognitive workload vary. As such, there is still a need to further develop our understanding of haptic cueing on performance and cognitive workload.

VALUE TO THE WARFIGHTER

One payoff is the hardware itself. Providing a cost effective way to integrate haptic cueing into multiple systems can help both the operator and system designer. Another potential payoff is to yield a clearer understanding of the performance benefits by using haptic cueing. The results of this effort can yield improved task loading capacity and performance for UAV operators.

FUNDING SPONSOR

Naval Air Systems Command
(NAVAIR)

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Unmanned Aerial System (UAS) operator display interface

DESCRIPTION

The goals of this research effort are to:

- Develop a low-cost, non-invasive, method of providing haptic feedback to an operator that can be easily integrated with multiple interfaces.
- Determine if this low-cost, non-invasive, method of haptic feedback can improve overall operator performance, in terms of response time and accuracy, and decrease mental workload.
- The results of this effort aided operator visual search performance, data analysis processes, and modified the Experience-based Questionnaire for Usability Assessments Targeting Elaborations survey.

NEED

There is a persistent need to improve operator performance and decrease mental workload when interacting with a complex system, such as those that require multitasking.

BENEFITS

This effort advanced the state-of-the-art in Commercial Off-The-Shelf (COTS) experimental testbeds by building a testbed that included large feature sets that are easy to use and cost-effective.

The results of this effort could help us to aid operator visual search, improve operator performance, reduce workload, and increase task loading capacity.

STATUS

In FY16, the team completed data collection under this effort, evaluating performance, cognitive workload, and system usability. To aid in data analysis, the team developed a data analysis tool. Results completed in FY17 showed that participants preformed significantly better in the cueing condition as supported by a decrease in missed targets and and false alarms. This was not a trade off with workload as NASA-Task Load Index Global was significantly lower in the cueing condition compared to the no cueing condition.

KEY ACCOMPLISHMENTS

- In FY17, the team completed data analysis, tested the automatic data analysis software tool, and transitioned the testbed to Research Exploring Multi-Operator Training Environments (REMOTE; WFD 219WFD-SG-14-027).
- Research Products:
 - Presented at the 2016 Annual Aerospace Experimental Psychologist Meeting (*"Developing COTS Products for Haptic Cueing"*)
 - Published conference paper at Human-Computer Interaction International 2016 (*"Integrating Methodology for Experimentation using Commercial Off-the-Shelf Products for Haptic Cueing"*)
 - Mentored Naval Research Enterprise Internship Program (NREIP) student, Matthew Molloy
 - Factor analysis resulting in a modified version of the Experience-based Questionnaire for Usability Assessments Targeting Elaborations survey
 - Developed an easy-to-use Python program for automatic data analysis
 - Estimated to save 40 hours of work per participant

UNMANNED SYSTEMS - TRAINING EXPERIMENTATION & SIMULATIONS (US-TES) LABORATORY



US-TES Lab Logo

DESCRIPTION

The US-TES lab provides emerging UxS/UAS technology to NAWCTSD personnel. The lab provides re-configurable user stations, hardware, pre-installed software, and technical expertise to qualified users. System Engineering, Instructional Systems Design, Test and others are able to deep dive into emerging systems without the overhead of operational systems.

NEED

In many cases NAWCTSD personnel have to travel to get hands on experience with emerging technologies. Once on-site, personnel are usually limited in time and availability on the system. To optimally perform their job personnel need to have access to the system and have the ability to modify key components. In operational settings time on the system may be very short with no modification permissions.

BENEFITS

With the ability of having in-house equipment for NAWCTSD personnel to perform on travel expenses and operational schedules can be reduced. Users that previously had to travel and schedule time on operational systems can now perform tasks in house with greater time on system with increased modification rights. Operational equipment or test ranges no longer have to be shut-down and modified for the NAWCTSD team to perform their job.

STATUS

Currently the US-TES lab is operational and running with the PMA-268 MQ-25 (Stingray) training team becoming the first user. MQ-25 personnel have successfully installed their UMCS Core 1.0 control station software and are using it to help create FAM training for the fleet.

PROJECT DURATION

OCT 2015 - SEPT 2026

OBJECTIVE

To provide a RDT&E lab for Human Systems and Training System Solutions in support of UxS/UAS environments. Support NAWCTSD users by providing the needed UxS/UAS hardware and software in a re-usable lab environment to help reduce cost, scheduling and technical risk.

VALUE TO THE WARFIGHTER

Cost, Scheduling and Technical risk associated with training emerging UxS/UAS technology can be reduced by having in-house equipment for NAWCTSD personnel to perform RDT&E on. NAWCTSD users can perform tasks that previously required travel in house reducing travel costs, increasing fidelity and providing a safe place for experimentation in place of operational equipment usage.

FUNDING SPONSOR

Program Management Activity
[PMA]-268 | Other Users

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KEY ACCOMPLISHMENTS

- Lab upgrade complete with improved physical access, HVAC and room refurbishment
- Installation of Hardware complete including re-configurable user stations and movable racks
- Installation of core operating systems complete (VMWare baseline)
- MQ-25 Stingray control station software (UMCS 1.0) installation complete
- Capital Investment Program (CIP) complete. Hardware and Software successfully purchased, integrated and tested

USER INTERFACE STRATEGIES FOR HUMAN-MACHINE TEAM TRAINING IN A SIMULATED SWARM TASK

PROJECT DURATION

NEW START

OCT 2017 - SEP 2019

OBJECTIVE

This project will compare the impact of multiple innovative display strategies on human-machine team training within a simulated multi-unmanned system scenario (i.e., swarm). Results will inform ongoing efforts to define user interface requirements for operator control of multiple, unmanned systems, as well as empirical evaluation of state diagrams and task-based interfaces to facilitate human-machine team training for swarm-based tasks.

VALUE TO THE WARFIGHTER

DOD and ONR have active research programs dedicated to the further research and development of innovative user interfaces to manage and team with complex, dynamic swarm teams. Accordingly, this project will enable us to extend ongoing efforts to define user interface recommendations for real-world applications (e.g., carrier-based swarm supervision).

FUNDING SPONSOR

Naval Air Systems Command
(NAVAIR) | Section 219

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Drone Swarm Illustration

DESCRIPTION

Through a continued collaboration with the Robotics and Intelligent Systems Engineering (RISE) Lab (Lakehurst) and NAWCTSD (Orlando), we will develop a simulated environment (i.e., prototype) whereby one operator will coordinate with multiple unmanned (ground and/or air) systems to execute ISR tasks. In a mixed factorial design, we will compare state-based diagrams and task-based interfaces to a default condition, in terms of human-machine team performance, operator mental workload and situation awareness.

NEED

This proposal aligns with multiple 4.6 Core Capabilities as outlined in the "Core Capabilities and Future Directions: Human Systems Department (AIR-4.6)" document. AIR-4.6 emphasizes "research, design, and development of human systems products." Specific capability development will be realized through "functional allocation and integration of advanced interaction technologies such as automation, decision aiding and data fusion."

BENEFITS

Autonomous systems are expected to produce extensive benefits to manpower, military capabilities, and mission success in future years, with the Department of Defense placing a high priority on continued research and development of these technologies (DOD Unmanned Systems Roadmap: 2013-2038).

STATUS

This project was started in October 2017. Current FY18 efforts will focus on design and development of experimental scenario and information displays (i.e., state diagram, task-based displays).

GOALS FOR FY18

- Design and development of experimental scenario and information displays (i.e., state diagram, task-based displays).
- Internal Review Board (IRB) protocol submission will be completed by end of FY18.

ADAPTIVE TRAINING FOR USMC CLOSE AIR SUPPORT TACTICS AND DECISION-MAKING



Screenshot from the Adaptive Training for Terminal Air Controllers (ATTAC) prototype

DESCRIPTION

Adaptive training (AT) is training that is tailored to an individual's strengths and weaknesses, and it has led to higher learning gains and decreased training time when compared to traditional training approaches in certain domains. However, more systematic research is needed to determine which AT techniques to employ, when to employ them, for what content to inform best practices, and when to invest in AT technologies. This research will examine the benefits of two particular AT techniques (i.e., adapting feedback and scenario difficulty) based on trainee performance in a scenario-based Close Air Support (CAS) decision-making task (e.g., game plan development) for Joint Terminal Attack Controllers (JTACs).

NEED

USMC Vision and Strategy 2025 and ONR's Science & Technology (S&T) Strategy for Warfighter Performance both highlight the need for tailored training that focuses on the individual learner. Adaptive training is well-suited to meet this demand.

BENEFITS

Additionally, this research will inform the military training community on AT best practices. This research has the potential to optimize classroom training time by allowing students the opportunity to practice key CAS skills on an individual basis, freeing up instructor time to focus on more challenging topics with the class.

STATUS

In FY18, there are two main thrusts of work planned. For Thrust 1, the team will continue to improve the ATTAC prototype by refining the assessment, feedback, and scenario difficulty algorithms and developing new scenarios. This thrust requires close collaboration with JTAC subject matter experts to ensure that the scenarios have appropriate face and content validity. For Thrust 2, NAWCTSD plans to conduct an experiment to test different schedules of feedback and scenario difficulty adaptations, which requires developing experimental materials and receiving IRB approval.

PROJECT DURATION
DEC 2016 - DEC 2019

OBJECTIVE

The goal of this effort is to perform systematic research on the efficacy of adaptive training (AT) for a complex decision-making task centered on the Joint Terminal Attack Controller (JTAC). Specifically, the AT testbed focuses on game plan development, a critical planning task that sets the stage for the execution of a Close Air Support mission and a challenging topic for JTAC trainees to master.

VALUE TO THE WARFIGHTER

JTACs must make many complex decisions in a short timeframe and have limited opportunities to practice critical skills in low-stakes environments, so AT presents an opportunity to offer the reps and sets necessary to improve the speed and accuracy of these decision-making processes.

FUNDING SPONSOR
Office of Naval Research (ONR)

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KEY ACCOMPLISHMENTS

- Attended Tactical Air Control Party (TACP) courses at Expeditionary Warfare Training Group (EWTG) Atlantic and Pacific to observe JTAC training and interview instructors to determine the topics with which trainees have difficulty
- Based on these observations and interviews, selected game plan development as the training content area
- Developed Adaptive Training for Terminal Attack Controllers (ATTAC) prototype. ATTAC:
 - Displays scenarios and assesses performance
 - Contains a working scenario difficulty algorithm that adjusts based on performance
 - Contains a preliminary working feedback algorithm that provides feedback tailored to an individual's response
- Created 20 unique scenarios with input from subject matter experts
- Workforce development opportunities:
 - Internships: Naval Research Enterprise Internship Program (NREIP)
 - Mentoring: 2 Ph.D. students from University of Central Florida

ELECTRONIC WARFARE (EW) TACTICAL DECISION AID (TACAID)

PROJECT DURATION

OCT 2015 - SEP 2018

OBJECTIVE

The technical objective of the EW TACAID project is to develop an adaptive training (AT) capability that will improve warfighter ability to manage an increasingly complex radio frequency (RF) environment while maintaining safety of ship. The goal is for the system to diagnose issues that the trainee is having in real-time, provide targeted feedback to correct those issues, and adjust the difficulty of the training if necessary.

VALUE TO THE WARFIGHTER

This program will deliver training to the fleet that is more effective than one-size-fits-all methods. Currently, sailors and submariners can only train EW in the schoolhouse. The new training system will reside on-board submarine tactical systems, allowing sailors and submariners to train while at sea. Thus, this provides a new capability for EW Operators to train while deep.

FUNDING SPONSOR

Office of Naval Research (ONR)

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SEW-AT start screen

DESCRIPTION

TACAID is developing and integrating AT approaches into on-board submarine systems. The Submarine EW Adaptive Trainer (SEW-AT) algorithms will diagnose the strengths and weaknesses of students in real-time as they perform actions during training, which are used to provide tailored instruction for each trainee. These algorithms include adaptations to the feedback based on trainee performance, as well as modifications to training difficulty. EW TACAID will provide two products: (1) AT software modules that are integrated with submarine tactical systems; and (2) a training system architecture that will reside within Next Generation BLQ-10 to support on-board training.

NEED

The EW Wholeness Campaign has identified a critical training gap in EW which is being partially fulfilled by SEW-AT. With the increasing complexity of the EW environment, there is a need to provide operators with more effective and efficient training. AT has been shown to be effective in the literature; however,

studies have mostly focused on simple tasks. Although some researchers have investigated more complex military environments, additional evidence would further support the use of AT for complex military tasks.

BENEFITS

Because the EW task is particularly challenging and dynamic, research that emerges from this program will expand the empirical base for the AT domain and open doors for its use in more complex tasks. The current state of the art with AT is based on simple tasks, but this project will inform sophisticated algorithm development for real-world, complex tasks. Early data with submariners show a 48% performance improvement (increased accuracy and timeliness of reports) after using SEW-AT. The adaptive algorithms developed through this project will improve upon current training capabilities, as research shows that AT enhances learning gains and performance compared to traditional training.

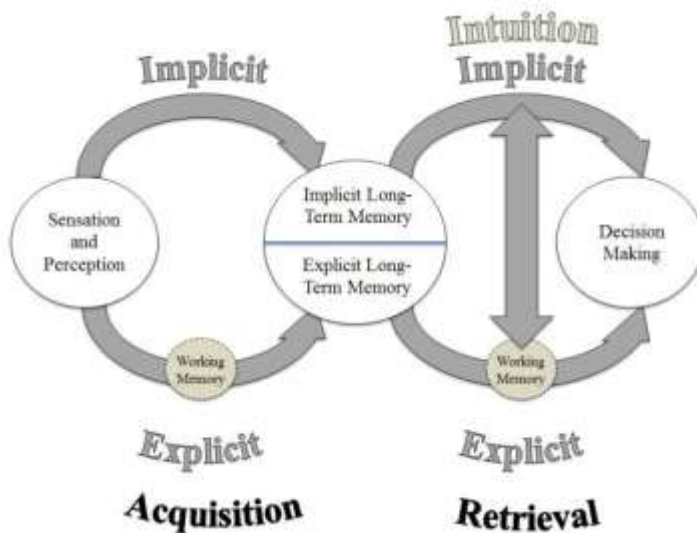
STATUS

We continued development of SEW-AT which includes refining adaptive algorithms and increasing the scenario library (currently have 100 dynamic scenarios and related course content reviewed by COMSUBPAC). We conducted 3 data collection events: 1 event at Submarine Learning Center (SLC), Groton and 2 events at Naval Submarine Training Center Pacific Joint Base Pearl Harbor. We have delivered 6 SEW-AT prototypes to SLC detachments and will provide system refreshes throughout the next year with new content and software updates. To get systems on-board quickly, SUBPAC has issued a Deviation from Requirements memo while we await an approved Authority To Operate (ATO).

KEY ACCOMPLISHMENTS

- Delivered prototype SEW-AT systems to 6 Submarine Learning Center Detachments.
- SUBPAC issued a Deviation from Requirements memo in order to get SEW-AT systems on-board in line with Speed to the Fleet initiatives.
- SEW-AT has been embedded in the submarine EW Wholeness Campaign Plan as a critical training element.
- Demonstrated SEW-AT to several Fleet stakeholders including CAPT Burian (Director for Training, Doctrine, & Tactical Development [N7] on the staff of Commander, Submarine Force, U.S. Pacific Fleet), CAPT Jaehn (Undersea Warfighting Development Center Norfolk; Submarine EW Wholeness Campaign Lead), and the Submarine Force Training Committee.

MEASURING INTUITION AND ITS RELATIONSHIP TO SOMATIC MARKERS AND INDIVIDUAL DIFFERENCES



Pictorial representation of the implicit and explicit memory and decision-making process.

DESCRIPTION

The current effort combines several bodies of research into one study to gain a better understanding of intuition and how it does or does not relate to individual differences and skills. The project advances the state of the art by combining existing intuition inventories with measures of basic cognitive skills and individual differences into one cohesive study in order to gain further insight into the durable intuitive process so that we can improve our understanding and thus effective usage of implicit strategies.

NEED

This is a basic research investigation that will assist in determining if deeper processes are at play when individuals are learning implicitly and using their intuition when making decisions.

BENEFITS

The knowledge we gain from this research may be leveraged to significantly increase our capability to measure and understand intuition and how it might be used for selection or training in the future. The results from this effort will lend guidance for how to test, select, and possibly even train personnel for positions that require the use of effective intuitive decision making. Effective intuitive decision making has been responsible for saving many lives and the more we understand this process the more we can do to hone these skills.

STATUS

This effort was completed on December 31, 2016. A full first draft of the results was submitted for journal publication. Edits to the publication, based on reviewer feedback, are in process. Correlation analyses were conducted and found that the Iowa Gambling Task (IGT) was positively correlated with intelligence ($r = .25, p < .01$) and working memory ($r = .12, p = .02$). The Gestalt Closure Task was positively correlated with working memory ($r = .20, p = .02$). These results suggest that individual differences, such as cognitive and perceptual abilities, could aid in the acquisition of implicit memory and intuitive decision making.

PROJECT DURATION
OCT 2013 - DEC 2016

OBJECTIVE

This study investigated the relationship between intuitive decision making, individual differences, cognitive and perceptual skills, and implicit learning to determine if individual differences and/or cognitive and perceptual skills are related to measures of implicit learning and intuition. Previous research has been mixed on whether individual differences or skills have an impact on intuitive processes and thus this study looked at many of those skills and traits all in one investigation.

VALUE TO THE WARFIGHTER

Understanding the intuitive decision making process may help select or train warfighters to avoid dangerous situations. This will aid in decision making training.

FUNDING SPONSOR
Naval Air Systems Command
(NAVAIR)

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KEY ACCOMPLISHMENTS

- Journal publication in review:
 - Steinhauser, N. B., Dehne, S. D., Cooper, T. T., & Bowens, L. D. (2017). Individual Differences in Implicit Learning and Intuitive Decision-Making. Manuscript submitted for publication.
- Presentation:
 - Steinhauser, N., Dehne, S. & Cooper, T. (2016). Individual Differences in Implicit Learning and Intuitive Decision Making. Presentation given at the SAFE Symposium, Dayton, Ohio.

METHODS FOR ACTIONABLE MEASURES OF ABSOLUTE COGNITIVE WORKLOAD

PROJECT DURATION

MAY 2015 - MAY 2018

OBJECTIVE

To develop an innovative and cost-effective capability that will provide an objective, measurable means of workload for determining impacts on individual operator, crew-level, and/or multi-team system level performance when life support or aircrew systems are added or modified.

VALUE TO THE WARFIGHTER

This effort will result in the development of a tool to objectively assess and quantify how ergonomic factors (weight, bulk, posture, heat, cold, perspiration, long missions, seat discomfort, and inability to stand up straight for hours) degrade the abilities of mobile aircrew or seated pilots to execute mission-critical tasks that are primarily reliant upon mental sharpness and persistence.

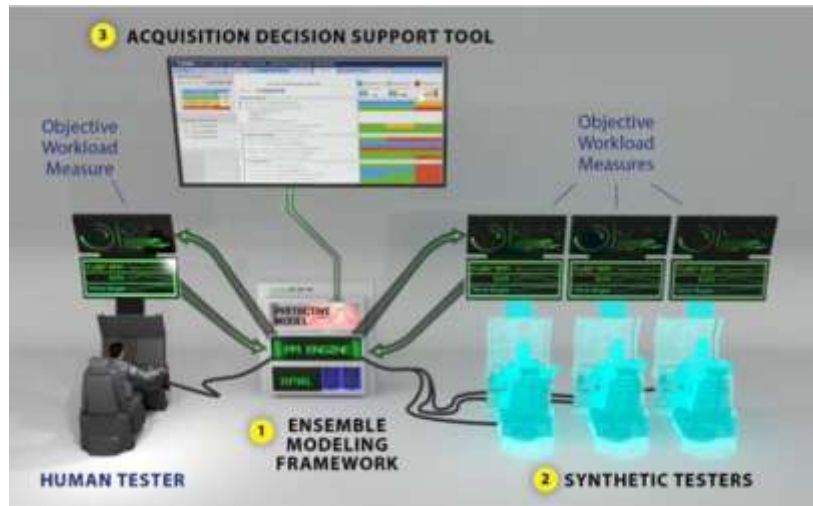
FUNDING SPONSOR

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Aptima's Tools for Objective Measurement and Evaluation applied to a notional T&E environment.

DESCRIPTION

In the Naval community, improving affordability is one of the main focus areas. Specifically, standardized workload management systems have been deemed one essential component to gain increased affordability. It is critical to know human performance limitations when introducing complex, cognitive tasks and state-of-the-art technologies, equipment and new environments to warfighters. Knowledge of these limitations can help researchers and developers understand and evaluate the potentially negative impacts on safety and the efficiency of operations. This effort develops a hybrid approach to objectively assess aircrew workload.

NEED

Current state-of-the-practice is to assess workload, either physical or cognitive, through a variety of assessment methods. The most commonly implemented are subjective measurement techniques; however, there is an increased desire for more objective data on which to base decisions. A variety of objective

measurement techniques exist for cognitive workload including performance measures. New, cost-reducing methods are needed to support systems acquisition decisions, and these will need to improve on existing methods.

BENEFITS

This effort seeks to investigate a hybrid approach that would allow for the real-time measurement of physical and cognitive workload and, with the results and modeling capabilities, understand how variations in the associated factors might impact operator safety and performance.

STATUS

Designed and demonstrated multiple systems that evaluated workload. These systems include: (1) a Sensor Suite, including forehead and peripheral sensors; (2) algorithms to extract, process, and fuse sensor data paired with algorithms to interpret data to assess cognitive and physical workload; (3) algorithms to extrapolate effects of skill acquisition on workload to predict performance changes due to expertise development; and (4) a user interface to understandably present output.

KEY ACCOMPLISHMENTS

- Institutional Review Board (IRB) Approval
- Delivery of (2)PMA prototype toolkits

TECHNIQUES TO ADJUST COMPUTATIONAL TRENDS INVOLVING CHANGING DATA (TACTIC-D)



SAN DIEGO (JULY 11, 2016) Racks containing Naval Integrated Tactical-Cloud Reference for Operational Superiority (NITROS) capabilities reside on the USS Carl Vinson (CVN 70) during Trident Warrior. Sheer amount of data being collected and stored on the cloud are vast. Proper collection, analysis, and visualization is still problematic.

DESCRIPTION

The continued push for integrated warfare will likely result in cross-platform, mission-based trends; however, there may be differences in constructs across platforms (e.g., one platform may rely on timeliness and another on accuracy) that if not accounted for in the analysis or development of common construct definitions would skew analysis results. This effort seeks to identify statistical or computational methods that can assist with these adjustments to statistical trends, and implement them in an automated tool that will allow for the timely and continued calculation of trends related to fleet performance and proficiency.

NEED

The DoD and USN seek to leverage the benefits of qualitative data analytics for tactical proficiency assessment to support decision making. Military domains for big data is unique in that the tactics, techniques and procedures used by the fleet shift over time due to changes in capabilities or the need to adapt, creating a unique challenge for the typical statistical processing to ensure that comparisons remain meaningful.

BENEFITS

Navy leadership has called for technologies that support analytics of big data sets such as avionics and human performance; however, as new systems or technologies are introduced and/or new tactics emerge to maintain superiority, underlying data sources may change. At this time, systems are built to support basic trends and statistical outputs, without accounting for this shift. Given the implications of decision makers relying on outputs to adapt training, modify resources or refine tactical approaches, a solution for understanding the implications or adjusting results based on these types of shifts is required. Advance statistical or novel modeling techniques are sought to address this unique challenge.

STATUS

This STTR has undergone competitive source selection to award Phase I. The selected three contractors will spend Phase I conducting feasibility analyses and designing/developing prototypes. The awarded industry partners will participate in initial kick-off meetings with the government stakeholders in October 2017 to discuss Phase I plans.

PROJECT DURATION

* NEW START *
SEP 2017 - SEP 2020

OBJECTIVE

Develop technology based on statistical or computational methods to assist in the continued tracking of training performance and proficiency trends as underlying tactical data changes.

VALUE TO THE WARFIGHTER

The results of trend analysis are desired to make decisions on mission personnel, training efficiency modifications, and resource allocation. The development of robust analyses methods that account for data changes over time will increase mission capability by providing more accurate information, and increase operator performance through training effectiveness evaluations.

FUNDING SPONSOR

Naval Air Systems Command
(NAVAIR)

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GOALS FOR FY18

- Proof of concept of technologies
- Government review of technology feasibility and down select to one awardee

TRANSITION OF CREW ROLE-PLAYER ENABLED BY AUTOMATED TECHNOLOGIES TO MARITIME PATROL TRAINING

PROJECT DURATION

NEW START

OCT 2017 - SEP 2020

OBJECTIVE

This effort will conduct the research and development necessary to refine the Crew Role-player Enabled by Automated Technology Enhancements (CREATE) technology, under development as part of NAVAIR SBIR N142-090, to facilitate transition to PMA-205 and PMA-290. The project will focus on conducting human factors analyses, investigating the potential to leverage the technology to support automated performance measures focused on communication skills, and conducting system performance testing.

VALUE TO THE WARFIGHTER

This effort will advance the understanding of synthetic role-players within training, and provide the means through usability analyses to increase the efficiency and effectiveness of the instructional capability. Additionally, the successful maturation and transition of this technology to naval aviation will result in increased fidelity in training and decreased operator workload.

FUNDING SPONSOR

Naval Air Systems Command (NAVAIR) | Section 219

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Aircrewmen assigned to Patrol Squadron (VP) 8 perform pre-flight procedures aboard a Boeing P-8A Poseidon maritime aircraft in preparation to support search and rescue efforts for the missing Republic of Korea cargo ship crew in the FOURTH Fleet Area of Operations

DESCRIPTION

The CREATE technology development has progressed significantly over the last two years, resulting in increased interest in harnessing the technology by platforms. However, work to date has focused on the challenges associated with the integration of speech and behavior modeling technologies. As platforms move forward with activities to implement this technology, greater attention is necessary to refine the instructional interface to ensure that an appropriate amount of data is provided that will facilitate human-machine trust without placing additional unnecessary workload on operator on operators. Attention to these factors will ease transition by ensuring usability and increasing buy-in.

NEED

The successful transition of autonomous crewmembers technology seeks to solve a long-standing training challenge - how to train a single trainee in a task that requires a crew or group to execute it. Through a software solution for autonomous crewmembers that builds on recent technological advances in speech recognition, this technology transition effort has the potential to reduce operator workload and facilitate more robust and realistic training of skills such as crew coordination earlier in the training pipeline.

BENEFITS

SBIR work has focused on the challenges associated with the integration of speech and behavior modeling technologies. As platforms move forward with activities to implement this technology, greater attention is necessary to refine the instructional interface to ensure that an appropriate amount of data is provided that will facilitate human-machine trust without placing additional unnecessary workload on operators. The lack of attention to these factors now, ahead of transitions, will result in schedule and financial impacts to programs to address usability issues identified after fielding. Additionally, increased usability at the on-set will increase fleet buy-in and increase the likelihood of successful fielding.

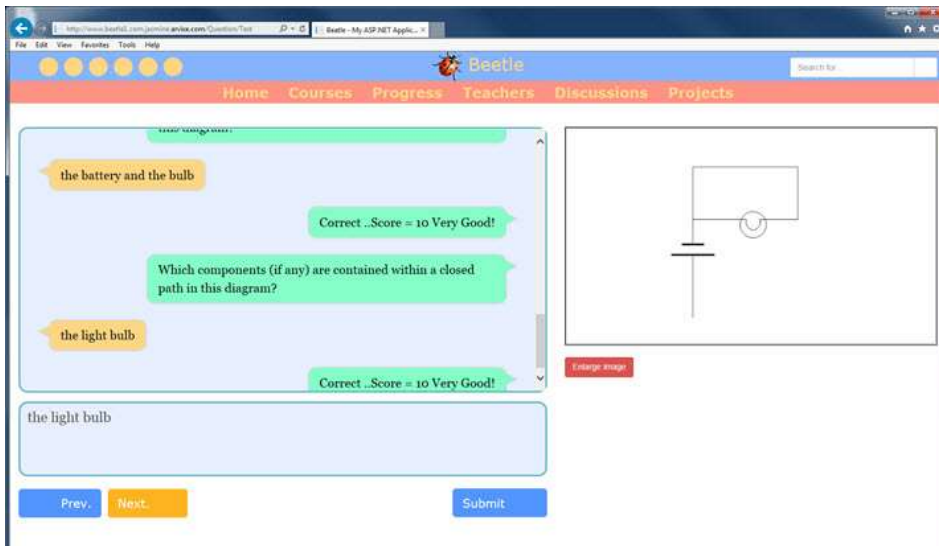
STATUS

This effort was selected for award as a FY18 new start. First year tasking in FY18 will focus on human factors analyses of existing instructional interfaces, research opportunities for advanced performance assessment through communication capabilities, and fleet testing of the component capabilities and integrated system performance.

KEY ACCOMPLISHMENTS

- Manuscripts/Publications: Atkinson, B. F. W., Killilea, J. P., Stensrud, B., Marinier, B., Schermerhorn, P., Dettmering, C., Saadat, S., & Anania, E. C. (2017). *Crew role-players enabled by automated technology enhancements*. Proceedings of the Interservice/Industry Training Simulation & Education Conference, Orlando, FL.
- Presentations: Anania, E. C., Atkinson, B. F. W., & Killilea, J. (2017, October). *The application of automation systems for training - Implications of trust*. Presenting at the SAFE Symposium, Orlando, FL.
- Demonstrated as part of the U.S. Navy exhibit at I/ITSEC 2017.

BASIC ELECTRONICS AND ELECTRICITY LEARNING ENVIRONMENT (BEETLE) II TRANSITION



Screenshot of the prototype web application developed in the course of this project

DESCRIPTION

This research seeks to investigate feasibility of transitioning the Office of Naval Research (ONR) Discovery and Invention (D&I) sponsored research in BEETLE II from a closed Linux-based system to a web accessible application. BEETLE II was developed in partnership with the University of Edinburgh to advance the state-of-the-art in Intelligent Tutoring System (ITS) capability. Research funded through the ONR D&I program was conducted to advance methods in dynamic adaptive feedback generation and natural language processing (NLP) by extending symbolic NLP techniques in the context of a dynamically changing simulation environment in a moderately complex domain.

NEED

Originally, BEETLE II was developed in partnership with the University of Edinburgh to advance the state-of-the-art in Intelligent Tutoring System (ITS) capability. Research funded through the ONR D&I program was conducted to advance methods natural language processing (NLP) to support unrestricted student natural language input in ITS. Both the Navy's Submarine Learning Center and the DoD Educational Activity have expressed interest in using BEETLE II as an instructional tool if the tool could be transitioned to a more accessible.

BENEFITS

Transitioning BEETLE II from a closed Linux-based system to a web accessible application would provide the interface needed to permit educational institutions the ability to use this courseware widely as an education tool. As a web application, educational institutions would

be able to use the tool without requiring specialized hardware and ease their burden with centralized maintenance of the system. This offers the opportunity to develop the platform from which additional courseware could be developed and shared to deliver an efficient and effective learning experience. The underlying technology also has the potential to improve training simulation as it extends to phraseology rehearsal and asset managers.

STATUS

This project concluded in FY17. In the conclusion year, a semantic similarity algorithm was ported to a prototype web application. The application runs in a chat-like interface accompanied by instructional slides that present the user with concepts. The intelligent tutor presents questions and evaluates the student responses. Although the application would still benefit from further refinement of the knowledge base using more data, this approach can provide meaningful results within a domain.

PROJECT DURATION OCT 2015 - SEP 2017

OBJECTIVE

Determine feasibility of transitioning Office of Naval Research (ONR) sponsored research in the Basic Electronics and Electricity Tutorial Learning Environment (BEETLE II) Intelligent Tutoring System from a closed Linux-based system to a web accessible application.

VALUE TO THE WARFIGHTER

Development of a prototype Intelligent Tutoring System that is accessible ubiquitously through a web interface without the need for specialized hardware that is centrally maintained for multiple users. The system is easily extensible with additional courseware and development of in-house expertise in underlying technology can improve training simulators as it extends to phraseology rehearsal.

FUNDING SPONSOR

Naval Air Systems Command
(NAVAIR) | Section 219

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KEY ACCOMPLISHMENTS

- FY15 - Academic Colloquium with NAWCTSD and the University of Edinburgh. Information sharing and collaborative forum for NAWCTSD and the University of Edinburgh.
- FY15 - Internship - Mentoring through Naval Research Enterprise Internship Program (NREIP)
- FY16 - Published and Presented at the SAFE Symposium. Ouakil, L., Ouakil, H. Speech and Language Processing in Navy Training.
- FY17 - Intelligent Tutor System (ITS) Prototype. ITS prototype with knowledge base and semantic processing algorithms developed as web application.
- FY17 - Final Report and consultation with ORTA for potential intellectual property protection.

EVALUATING ROBOT USER DISPLAYS TO INVESTIGATE TEAM EFFECTIVENESS (ERUDITE)

PROJECT DURATION
OCT 2015 - SEP 2017

OBJECTIVE

The project investigated information display strategies for supervisory control of multiple autonomous robots within a carrier-based environment. Display strategies such as color-coding and artificial intelligence were evaluated in terms of their impact on human-system performance and subjective measures including situation awareness and mental workload.

VALUE TO THE WARFIGHTER

This project investigated information display strategies to enable a single operator to supervise and control multiple autonomous systems simultaneously. Optimal information displays will enhance human-system performance by increasing situation awareness and decreasing mental workload, thereby reducing manpower requirements and extending human-system performance capabilities.

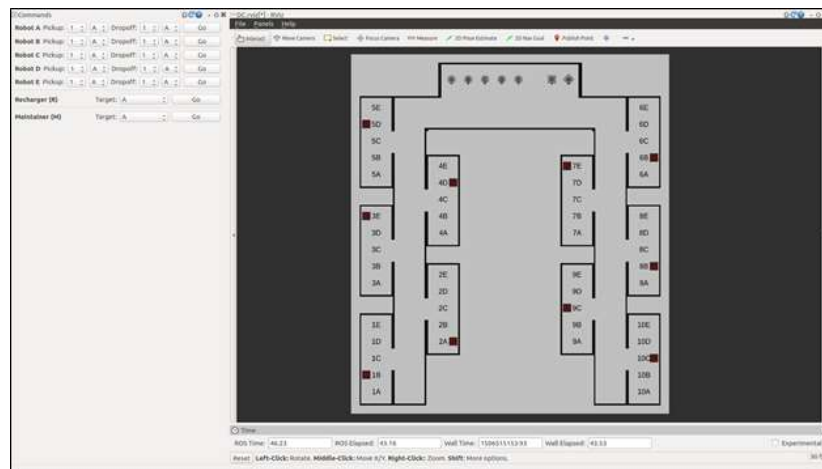
FUNDING SPONSOR

Naval Air Systems Command
(NAVAIR) | Section 219

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ERUDITE v1 User Interface

DESCRIPTION

In a within-subjects design, participants completed three 15-minute test sessions in each experimental conditions (color-coded, artificial intelligence, default). Dependent measures included objective performance measures (i.e., mean response time; event response rate) and subjective measures of situation awareness and mental workload. Significantly higher stress levels were indicated for the default condition, compared to the color-coded and artificial intelligence conditions.

NEED

Robotic swarms have been touted as a way of improving sortie rate as well as reducing manpower needs and total ownership cost, yet their successful utilization will require optimal user interfaces that facilitate effective supervisory control of autonomous systems. This project supports STO-6: Aircraft/Ship Integration and S&T Research Area focused on Autonomous Systems.

BENEFITS

Autonomy within the Navy is an important focus, as laid out in the Naval S&T Objectives. This project evaluated different information display strategies and their impact on human-system performance for control of multiple autonomous systems. Recent research & development efforts have resulted in rapid advancements in autonomous systems, including path planning algorithms for controlling swarms of autonomous vehicles on a carrier. However, we do not yet have effective user interfaces to adequately control and supervise these swarms outside of a lab environment. This project will contribute to user interface designs that will enable supervisory control of multiple autonomous systems by a single operator.

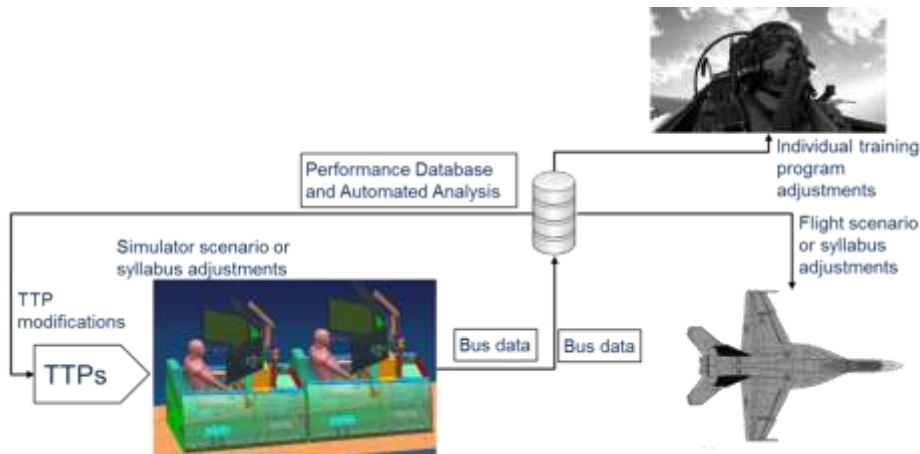
STATUS

This project was completed at end of FY17. Results indicated that using color coding visual summaries for each robot in a swarm significantly reduces stress and workload of the supervisor.

KEY ACCOMPLISHMENTS

- ERUDITE v1 Prototype completed and available for future research
- Government Technical Report
- Paper for Publication - In Preparation

FLEET ADAPTIVE MULTILEVEL MEASUREMENT FOR OPERATIONS & UNIT SYSTEMS (FAM2OUS)



Developing LVC multiteam performance measures

DESCRIPTION

The science and technology of this FNC will focus on developing an assessment architecture that will automatically and adaptively collect, fuse, display, analyze, and archive training data (Live, Virtual, Constructive) from disparate systems. Intelligent performance measurements will be developed using machine learning algorithms that can adjust as the tasks, tactics, and student ability changes. Data fusion techniques will also be used to automatically synthesize data from disparate sources and systems. These data will be stored in a centralized system that will enable rapid development of post-mission and readiness reports.

NEED

Performance assessment of Carrier Airwings (CVWs) during integrated training relies solely on qualitative instructor assessments presenting resource challenges with manpower, training time for instructors, standardization of metrics and feedback, and overall accuracy of recorded data. This practice requires instructors to pull data from multiple, disparate, often stove-piped systems and manually synthesize these data to conduct debrief and provide assessments which is time intensive.

BENEFITS

This capability will provide instructors with relevant data that is automatically fused to allow for increased for a reduction in manpower and time requirements for instructors. This will also reduce instructor workload focused on assessment and allow for increased quality of instruction and ultimately greater warfighter proficiency and readiness. Finally, this tool will allow for comparison between simulator and flight performance, assess the effect of simulator rehearsal on live flight proficiency, and enable development Concept of Operations and refinement of Tactics, Techniques, and Procedures (TTPs).

STATUS

FAM2OUS is a Pre-FNC and has plans to kick off in FY18 with a focus on developing the baseline architecture for intelligent performance measurements that can adjust as the tasks, tactics, and student ability changes.

PROJECT DURATION

★ NEW START ★
DEC 2017 - OCT 2019

OBJECTIVE

Develop a tool to automatically collect, fuse, display, analyze, and archive Carrier Airwing training data from disparate media and systems.

VALUE TO THE WARFIGHTER

The Fleet lacks system-of-system capabilities to collect automated, objective performance assessment during training. As such, all assessment data is captured through instructor observation which is cumbersome, sometimes inaccurate, and may result in lost learning opportunities as attention is focused on assessing rather than instructing.

FUNDING SPONSORS

Office of Naval Research (ONR);
Naval Aviation Training Systems
Program Office (Program
Management Activity [PMA] 205)

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GOALS FOR FY18

- Evaluate initial performance measurement specification.
- Establish and create a draft architecture design.

INVESTIGATION OF TRAINING FIDELITY FOR CARRIER QUALIFICATION AND PRECISION LANDING MODES

PROJECT DURATION

NEW START

OCT 2017 - SEP 2020

OBJECTIVE

This effort will research the level of flight simulation fidelity required for the carrier landing training using Precision Landing Mode (PLM) flight control laws. Deliverables include 1) data analytics reports that identify training gaps and performance issues for both pilots and LSOs, 2) simulated and live data that will be leveraged for the LSO virtual reality (VR) trainer and computational pilot models, and 3) empirical reports documenting solutions for training gaps and performance issues.

VALUE TO THE WARFIGHTER

PLM is scheduled to be fully implemented into the cockpit by the end of FY 18 reliant on stop gap training technology (e.g., NAWCAD created LCTs). While current capabilities have proven very effective, it has also exposed training and planning gaps that can be fixed for full ground up training following FY19 testing and implementation if appropriately evaluated.

FUNDING SPONSOR

Naval Air Systems Command
(NAVAIR) | Section 219

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Landing Signal Officers (LSOs)

DESCRIPTION

Precision Landing Mode (PLM) refers to a set of control laws that adds additional landing modes designed to improve pilot landing and recovery capabilities. These control laws decrease workload for pilots and improve aspects of recovery and landing performance (e.g., centralized landing patterns). However, the reaction of the aircraft to inputs from the pilot is different and the techniques of Landing Signal Officers (LSOs) waving pilots land at the ship may need to change. This will necessitate adjustments to pilot skills sets, disrupting long automated muscle memory and decision making for expert pilots and introduce more complex learning for novice pilots due to additional modes.

NEED

Originally planned for initial roll out early in FY18, integration started over a year early (Q4FY16) and is estimated to be fully integrated by the end of FY17. This early delivery of the PLM upgrade technology may result in pilots being undertrained as they struggle with either learning techniques for multiple modes or unlearning long held habits and muscle memory reactions under quick timelines and dangerous conditions (experts). This can present its own set of challenges such as negative impacts on muscle memory maintenance and mode confusion.

BENEFITS

First, the relationship between simulation fidelity and transfer/learning area is generating significant attention in the Navy as we shift toward less live flight training and more simulation-based training, to save cost and increase safety. Thus, a need exists within the Navy to empirically evaluate theories of training transfer and fidelity in the environment when new technology is introduced and Fleet requirements change. Furthermore, this effort will provide a significant contribution to the scientific community in that it will provide an understanding of the relationship between fidelity and learning in highly complex, dynamic military environments.

STATUS

Project kick off in October 2017 and plans are being made to coordinate with other partner agencies. First major data collection is scheduled for Jan 2018.

GOALS FOR FY18

- Planning and development of experimental protocol and timeline.
- Analyze fleet data.
- Update low and high fidelity simulators.

NAVAL INTEGRATED FIRE CONTROL – COUNTER AIR (NIFC-CA X)



DESCRIPTION

Initial proof-of-concept capability developed in FY14 was a collaboration between NAWCAD/TSD and government contractors. Phase 1 delivered a classroom-based tool utilizing a streamlined version of the NGTS's Battle Monitor to provide a "god's-eye view" map of a scripted NIFC-CA scenario. This enabled trainees to make decisions regarding how to counter a small number of threats, provided after action review and feedback. Phase II and II.5 have expanded content and feedback for Tactical Training Group Atlantic/Pacific (TTGL/P), and E-2D Fleet Readiness Squadron (FRS).

NEED

As integrated warfare capabilities like NIFC-CA become increasingly important to Navy's Carrier Strike Groups, the requirement for Virtual and Constructive training environments becomes increasingly necessary in order to provide true systems-of-systems and multi-team training. Currently, the integrated commands are significantly limited in the training they can provide and most of that is

only done live based on LVC limitations training.

BENEFITS

This capability provides the Fleet with a mission visualization tool for classroom based training allowing for visualization during the scenario, collaborative decision making, and feedback on performance to enable readiness and cross platform coordination. Additionally, the high fidelity, physics-based models developed for NIFC-CA X are resident in the NGTS and therefore can also support simulation-based training for NIFC-CA.

STATUS

The tool is being enhanced under funding from the Small Business Innovative Research program to support a more flexible architecture including: the ability to manipulate the blue force laydown, scale threats to meet training objectives, and flexible performance assessment architecture. Requirements have been generated to support E-2D FRS training and development underway. Finally, Phase 2 capabilities are being delivered to Truman Strike Group for further evaluation.

KEY ACCOMPLISHMENTS

- Receipt of the 16th Annual Naval Air Warfare Center Aircraft Division Commander's Award
- Phase 2 capability delivered and demonstrated to TTGP (JUL 2017)
- Truman Strike Group utilized NIFC-CA X during AD Syndicate (JUL 2017)
- Phase 2 Demonstrations:
 - Surface Warfare Officer School (APR 2017)
 - PMA-231(JUN 2017)
 - PMA-298(JUN 2017)
 - PMA-265 (JUL 2017)
 - Naval Air Warfare Development Center's Air Defense Strike Group Facility and Carrier Airborne Early Warning community (SEP 2017)

PROJECT DURATION

MAR 2014 - OCT 2018

OBJECTIVE

This effort fills a critical training gap in the NIFC-CA community by leveraging existing investments from the Live, Virtual, and Constructive (LVC) Training Fidelity Enabling Capability. Specifically, ONR funded an AIR 4.6.5-led effort coordinated with 5.4 focusing on the development of a mission visualization capability that can be used to train cross-platform coordination associated with NIFC-CA employment utilizing the core LVC technologies.

VALUE TO THE WARFIGHTER

NIFC-CA X provides a mission visualization tool for classroom-based training allowing for scenario visualization, collaborative decision making, and feedback on performance to enable readiness and cross platform coordination. Additionally, these high fidelity, physics-based models are resident in NGTS) and therefore can support simulation based training.

FUNDING SPONSOR

Office of Naval Research (ONR)

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SQUAD OVERMATCH (SOvM)/TEAM OVERMATCH (TOvM)

PROJECT DURATION

JAN 2015 - SEP 2020

OBJECTIVE

FY18 objectives are to develop team resilience strategies that focus on a) the recognition of self/buddy cues that indicate performance degradation when experiencing stress (e.g., CQC/urban combat with injuries) and b) applying specific 'tactical resilience care' team behaviors to mitigate performance degradation. The emphasis on in-the-moment, tactical resilience care provided by team members has the potential to provide a game-changing approach to reducing the impact of stressors on performance.

VALUE TO THE WARFIGHTER

Soldiers and Marines can experience extreme stressors in the operational environment. Current approaches do not focus on resilience first aid that can be provided at the point of injury. This effort will develop and evaluate an innovative approach to training self and buddy aid for managing combat stress reactions (CSR).

FUNDING SPONSOR

Defense Health Agency (DHA)

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UL: Marines from the 2/8 Fox Company participate in an integrated After Action Review (iAAR).

UR: A Marine from the 2/8 Fox Company participates in virtual scenario training using Virtual Battlespace 3 (VBS3)

LL: Soldiers from the 25th Infantry Division PACOM prepare to execute a Squad Overmatch live scenario

LR: Marines from the 2/8 Fox Company set up a Casualty Collection Point in a Squad Overmatch live scenario

DESCRIPTION

This effort will develop an innovative, advanced Team Resilience / Psychological Health training module that is fully embedded into tactical training. Innovative resilience strategies will focus on the quick recognition of CSRs in self and buddies, and in quick treatment (resilience first aid). This has the potential to reduce performance degradation in the field, and in providing stress treatment early.

NEED

It has been estimated that for every one physical injury, there are 4-8 stress injuries (Col Bar, 2010). There is a need for Resilience training for Joint forces that optimizes performance, and mitigates the effects of stressors encountered on tactical performance.

BENEFITS

In a short (3-4 day) integrated curriculum, soldiers and Marines will receive training that provides empirically evaluated improvements in individual and team performance for tactical and process skills (i.e., tactical combat casualty care, situation awareness, resilience). Once the curriculum is designed and evaluated, it will be uploaded to a train-the-trainer package that supports unit-led training.

STATUS

Operational Implementation:

- U.S. Army Central Command (USARCENT); 3rd/1st Armor Brigade Combat Team, Camp Buehring, Kuwait
- II Marine Expeditionary Force (IIMEF); 2nd Marine Division (2MARDIV), Camp Lejeune, NC
- U.S. Army Pacific Command (USARPAC); 25th Infantry Division, Schofield Barracks, HI

KEY ACCOMPLISHMENTS

- Johnston, JH, Phillips, H., Irizarry, D., Milham, L., Riddle, D., Townsend, L., Gamble, K., Fitzhugh, S., Patton, D., Butler, P., Evans, M., & Wolf, R. (March 2017). *Squad Overmatch: Phase 2 Final Report*. PEO STRI: Orlando, FL. Unclassified/FOUO.
- Townsend, L, Johnston, J, Ross, W, Milham, L, Riddle, D, Phillips, H, Woodhouse, B. (2017). *Development of a Mobile Tool for Dismounted Squad Team Performance Observations*. In: Proceedings of the 2016 Annual Meeting of the Human Computer Interaction International (HCII) Conference. Vancouver, Canada.
- Achievement Medals for Civilian Service for Laura Milham, Dawn Riddle, and Lisa Townsend individual/personal for their leadership in the SOvM effort (2017).
- 2016 NTSA Modeling and Simulation Award for Training,
- PM TRADE Team of the Quarter (2017).
- Certificates of Appreciation from the NAWCTSD CO.

ACCELERATING THE DEVELOPMENT OF SMALL UNIT DECISION MAKING (ADSUDM)



Left: HoloLens SandTable application. Right: ADSUDM Operational Integration Concept

DESCRIPTION

ADSUDM features 3 interoperable software components that collectively form the overall Decision-Making (DM) training capability. Central to the architecture is a relational database that provides a persistent store of Marine performance data that can be accessed and annotated to support streamlined after-action review, personalized curriculum delivery, and performance analytics data for unit leaders. ADSUDM also includes an adaptive trainer that monitors student performance and provides embedded tutoring and scenario adaptation focused on terrain reasoning skills. Lastly, ADSUDM integrates software tools for instructors to rapidly generate relevant real-world terrains to support DM training.

NEED

- 1) Expeditionary Force 21
- 2) 37th Commandant of the Marine Corps FRAGO 01/2016 and the USMC 36th Commandant's Planning Guidance 2015
- 3) SITE Initial Capabilities Document (ICD) (Gap 8 & 11) [NOTE: SITE is now ITRS]
- 4) FNC Gap 15-44: Training Time and Cost Reduction Technologies (e.g., ICD, CDD, etc.)
- 5) FNC Gap 16-46: Small Unit Decision Making Training Technologies
- 6) FNC Gap 16-45: Optimized Mixed Training Environments for Operations
- 7) DVTE CDD - system deficiency identified: After Action Review
- 8) USMC Force Development Strategic Plan 2015.

BENEFITS

The ADSUDM effort will improve small unit performance and decision making skills, save the Marine Corps both time and cost to train, provide additional reps and sets for decision making training, decrease the time required to develop squad leaders, and provide an After Action Review (AAR) capabilities after training event completion for both live and virtual training events.

STATUS

ADSUDM is in its second year of execution as a Future Naval Capability (FNC) effort. The first version of the ADSUDM tools were developed and are being tested by users and modified to maximize usability. Many demonstrations of the technologies have been given, including: IITSEC 2016 & 2017, SOI-East, 2nd Battalions/6th Marines, Modern Day Marine 2016 & 2017, Naval Future Force S&T Expo 2017, Infantry Officer Course, and to many stakeholders including PM TRASYS, TECOM, and the Assistant Commandant of the Marine Corps. The Tactical Decision Kits are being deployed to all battalions in the Marine Corps by the end of October 2017.

PROJECT DURATION
JUL 2016 - DEC 2018

OBJECTIVE

Enhance USMC simulation-based Small-Unit Decision Making (SUDM) training through multiple integrated software components: 1) Decision Making-Learning Management System (DM-LMS) for tracking trainee performance over time and providing After Action Review, 2) Digital Integrated Representation of Tactical Environment (DIRTE) tools for simulation terrain database generation, and 3) Simulation Tailored Training and Assessment (ST2A) that provides a situated tutor for virtual decision-making training.

VALUE TO THE WARFIGHTER

In the form of Tactical Decision Kits (TDKs), ADSUDM will (a) enable schoolhouses, for the first time, to explicitly train and dynamically assess squad leader Key Performance Areas [KPAs], and (b) enable training decision-making skills with targeted, individualized curricula tied to next-generation, simulation-based training through adaptive training and technology insertion.

FUNDING SPONSOR
Office of Naval Research (ONR)

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KEY ACCOMPLISHMENTS

- Yearly update to the Technology Transition Agreements (TTA) for ST2A, DIRTE, and DM-LMS
- Demonstrations: IITSEC 2017, Modern Day Marine 2017, Naval Future Force S&T Expo 2017, and to various USMC battalions, school houses, the Assistant Commandant of the Marine Corps, and to various other stakeholders including TECOM and PM TRASYS.
- Transition: The Rapid Capabilities Office (RCO) of the USMC transitioned initial versions of the ADSUDM software and hardware to the Tactical Decision Kits (TDKs) that were delivered to all battalions in the Marine Corps (24) in 2017.
- Data Collection and testing events with Marine Corps battalion: Spartan Tactical Games I, II, III, and IV.

AUGMENTED TRAINING FOR EXPERIENTIAL LEARNING FOR LANDING SIGNAL OFFICERS

PROJECT DURATION OCT 2015 - SEP 2018

OBJECTIVE

In an effort to mitigate the predicted impact of training optimization on the LSO training pipeline, we are working to 1) identify training challenges for LSOs in reaction to Navy training optimization, 2) identify and develop technologies to supplement live training opportunities for LSOs (and 3) develop and validate methods for implementing this technology within the LSO curriculum that can supplement LSO training issues resulting from reduced live training.

VALUE TO THE WARFIGHTER

While the LSO School leverages simulation based training, it is estimated that LSOs currently still require up to 1000 live landings to accurately calibrate their visual perception of aircraft deviations. Their ability to maintain these numbers in the face of reduced live flights for CQ will be a challenge. The introduction of supplemental training that can enhance this calibration.

FUNDING SPONSOR

Naval Air Systems Command
(NAVAIR) | Section 219

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DESCRIPTION

The objective of the Maritime Augmented Guidance with Integrated Controls for Carrier Approach and Recovery Precision Enabling Technologies (MAGIC CARPET) project is to provide the pilot with a control concept that is so easy to fly aboard the ship that minimizes initial training, proficiency and currency requirements. The science and technology includes control concepts that rely only on onboard sensor/control capability.

NEED

On the job training accounts for majority of LSOs training (i.e., Field Carrier Landing Practice, and the Carrier Qualifications). However, with improvements to carrier landing technology on some aircraft (e.g., MAGIC CARPET) and the push to optimize training and reduce costs, combined with current deployment schedules, reduction to CQ, FCLP, and time on the platform has left a training gap for live LSO training opportunities. Reductions in budget have also left gaps and deficiencies in the LSO operational trainer.

BENEFITS

Landing Signal Officers (LSOs) have a unique and important role in US Naval Aviation. Specific to ship board landings, LSOs are tasked with the "safe and expeditious recovery" of naval aircraft aboard aircraft carriers and are required to assess, coach, correct, and mentor pilots landing at the ship (LSO NATOPS Manual). LSOs currently still require up to 1000 live landings to accurately calibrate their visual perception of aircraft deviations. Their ability to maintain these numbers in the face of reduced live flights for CQ in general will be a challenge. The introduction of supplemental training that can enhance this calibration could address some of these challenges and is essential in moving forward with optimized training.

STATUS

Empirical training effectiveness study was delayed due to pilot availability but will be conducted in FY18 in conjunction with simulation based training upgrades (e.g., interactive recreations of seminal incidents as training content in simulator). Content, sample populations, and additional technologies have been identified. Development of simulation based content and improvements to content in LPT CBT are ongoing.

KEY ACCOMPLISHMENTS

- Developed LSO Pre-Training (LPT) Computer Based Training Application
- Completed technology review for VR
- Developed experimental plan
- Developed Performance and Training objective matrix
- Briefed LSO Training applications and research at LSO OAG
- Collected data on USS Dwight D Eisenhower (CVN69) during SUSTEX
- Priest, H., McNamara, C., Grubb, J., (2017, February 21). "Virtual/Augmented Reality in Naval Aviation Training: A Window into the Future." WEST 2017-San Diego.
- Products
 - LSO Pre-training
 - Planned Publications
 - Analysis findings to be presented at HFETAG (2018)
 - Experiment 1 findings to presented at HFES (2018) or AHFE (2018)
- Workforce Benefits
 - Mentoring Opportunities
 - Naval Research Enterprise Internship Program (NREIP) Intern (Engineering and Psychology): A. Neigel
 - Incoming NREIP Intern (Engineering and Psychology): Summer FY17
- Transition
 - Potential transition of instructional capabilities to LSO Trainer (existing) and CBT for use at LSO School at Oceana for Course pre-training
- Final Report from Training Analysis for LSO School Simulation based training.
- Measures for LSO Simulation Based Training.



COMPLEX-KNOWLEDGE VISUALIZATION TOOL



Quartermaster 3rd Class Sharon Stone checks coordinates on a computer on the bridge of the amphibious dock landing ship USS Ashland (LSD 48) during a replenishment-at-sea.

DESCRIPTION

The purpose of this Phase I STTR is to design a tool that provides acquisition decision support to high level decision makers. The design should handle the management and visualization of a complex and changing knowledge base related to the impact of technologies and instructional strategies on human learning and address questions such as: what is the time needed to train; what are the training system fidelity requirements to facilitate learning and transfer? The knowledge base should feature relevant research results from the educational and cognitive psychology research literatures, including topics such as transfer appropriate processing, levels of processing and automaticity.

NEED

The work performed for this effort supports the Advanced Training Systems Technology core competency.

BENEFITS

The tool will improve training system quality because it give its users -- training analysts and decision makers -- insight into 1) chief findings, 2) uncertainty and variety in the relevant research literature, 3) research gaps, and 4) impacts on the acquisition decision (e.g., learning benefits against short-term cost savings).

STATUS

In FY17, three performers were selected for Phase I STTRs. The Phase II selection process begins in December 2018.

PROJECT DURATION

MAY 2017 - DEC 2017

OBJECTIVE

The objective of this project is to develop a tool that synthesizes learning and cognitive science literature and provides compelling, data-based information and visualizations to support training system acquisition decisions; for example, the tool would allow such questions to be asked: "What is the return on investment if a debriefing system is included with the training system?"; and "What training system fidelity is needed to facilitate learning and transfer?"

VALUE TO THE WARFIGHTER

The tool will improve training system quality because defensible, learning science-based data and metrics can be added to the set of factors considered during the acquisition of training devices.

FUNDING SPONSOR

Naval Air Systems Command
(NAVAIR)

POINTS OF CONTACT

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GOALS FOR FY18

- Design an adaptable architecture and user-interaction framework that link the different elements of science with the types of questions outlined above.
- Design multiple competing design concepts.
- Develop representative and special-case use cases that ensure training science is represented accurately and takes into account stakeholder time constraints, goals, and priorities.

DISTRIBUTED VIRTUAL REALITY TESTBED

PROJECT DURATION

NEW START
OCT 2017 - SEP 2019

OBJECTIVE

The objective of this effort is to develop a distributed, multi-user virtual reality (VR) test bed. The test bed will enable virtual cooperative team training in which two or more students, who are in the same or different geographical locations, to execute team training tasks together in a virtual world.

VALUE TO THE WARFIGHTER

To perform this task, the workforce must learn methods for networking multiple VR devices together. The team will gain experience using realistic avatars so that each participant can effectively interact with other participants to accomplish team training tasks. These improved skills will result in a more capable workforce that is prepared to employ emerging VR tech to solve future training problems.

FUNDING SPONSOR

Naval Air Systems Command
(NAVAIR) | Section 219

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LCDR Ryan Kramer explores a simulated Virginia class submarine in the VR prototype for the Virtual Interactive Shipboard Instructional Tour® (VISIT®).

DESCRIPTION

Our technical approach is to leverage our existing single participant VR assets (e.g., HTC VIVE, Oculus Rift, 3D models, Unity scripts) and our technical experience to develop a framework for rapid, distributed, multi-user VR training prototype development. Our approach will also provide a cross-platform (e.g., Linux, Windows, macOS) distributed VR environment that will act as a template for future VR research, experimentation, and prototype development.

NEED

In many existing team training and collaborative environments, each individual is physically collocated (e.g., pilot/copilot, navigation bridge crew, maintenance team) in order to utilize physical equipment (e.g., cockpits, navigation equipment, gear being maintained). By placing virtual instances of the equipment in a shared virtual environment, it becomes possible for team collaboration without requiring geographic collocation.

BENEFITS

The proposed effort has multiple benefits for NAWCTSD. To perform this task, the workforce must learn the best methods for networking multiple VR devices together seamlessly. The team members must also gain experience using realistic avatars so that each participant can effectively interact with the other participants in the virtual world to accomplish team training tasks. These improved skills will result in a more capable workforce that will be better prepared to employ emerging VR technologies solve future training problems. The software libraries and packages developed as part of this effort can be reused and will allow the lab to leverage the experience to solve other problems in the domain of team tasks in networked VR.

STATUS

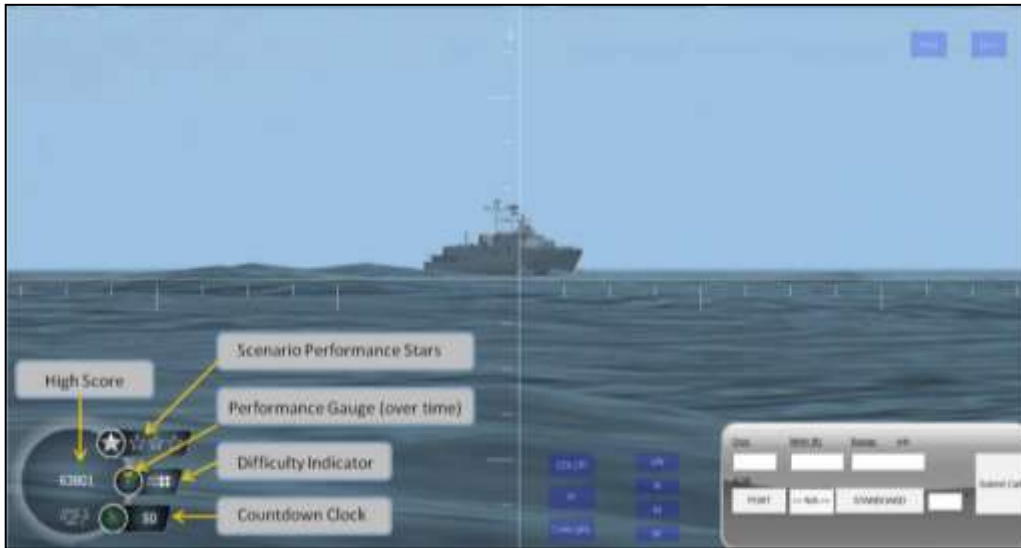
The FY18 Execution Plan is as follows:

1. Procure hardware and software assets to expand existing single user assets.
2. Create virtual space where users will interact.
3. Develop network libraries and scripts to place each user into the virtual space.
4. Place avatars in virtual space.
 - a. Develop scripts to track user position movement and move avatar position in virtual world.
 - b. Create network scripts to communicate avatar state to other users.

GOALS FOR FY18

For the first year of this effort, we expect to have at least two distributed users connected to a server and sharing the same virtual space. Our goal is to implement basic interactions between the players and voice chat.

EXAMINING THE EFFECTS OF GAME FEATURES ON LEARNING IN SCENARIO-BASED TRAINING



The Periscope Operator Adaptive Trainer (POAT) user interface with game gauges included (bottom left).

DESCRIPTION

Previous research has shown mixed results on the efficacy of game features to promote learning outcomes and motivation, and the majority of these studies have not systematically investigated game features to determine which ones are most effective. Based on Cognitive Load Theory, we hypothesized that adding both competition and game features would increase motivation and enhance performance in a simulation-based training task. In a set of experiments, we explored whether the presence of game features (performance gauges and score) and competition features (a leaderboard) affected motivation and learning outcomes within the Periscope Operator Adaptive Trainer (POAT).

NEED

In light of budget declines, there has been a strong push across the DoD for low-cost training techniques that are engaging, realistic, and can be delivered anytime, anywhere. Game-based training techniques hold promise to meet this demand as they are purported to enhance player motivation. However, existing research on the effectiveness of game-based training is mixed and often nonsystematic, resulting in a failure to identify specific game features that lead to better learning and performance outcomes.

BENEFITS

Game-based training may be well-suited to meet the Navy's education objectives, given the popularity of computer games with today's young adults. This research seeks to examine the effects of incorporating game features into simulation-based training, a topic that has not been systematically investigated in the training literature. Previous studies have assessed the value of game-based training over traditional

methods of instruction, but few have investigated individual game features and their impact on performance and motivation. The findings of these experiments may have a broad impact on current and future training systems by offering empirically-based guidance for designing and incorporating game features to enhance effectiveness.

STATUS

In FY17, the research team finalized the experimental testbed and completed the first data collection with approximately 120 participants from a nearby university. In our first study, we found that incorporating game features into training did not improve trainee performance on the task, or their motivation to play the game. Currently, the team is preparing for data collection with officers at the Submarine Learning Center in Groton, CT to assess if game features have an impact on trainees with higher intrinsic motivation to do well.

PROJECT DURATION OCT 2015 - SEP 2018

OBJECTIVE

The objective of this research is to systematically test the impact of two game features on performance and motivation: score/performance gauges and competition. To date, there is no previous research that suggests adding game gauges increases motivation or enhances performance, and likewise, little research has examined the effect of competition on learner performance and motivation in game-based training.

VALUE TO THE WARFIGHTER

Game-based training systems are already being delivered to the fleet despite little evidence that they improve trainee performance or increase motivation. Our research will systematically assess the impact of these features to ensure that game-based training delivered to the fleet represents a cost-benefit over traditional training systems.

FUNDING SPONSOR

Naval Air Systems Command
(NAVAIR) | Section 219

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KEY ACCOMPLISHMENTS

- Completed data collection for Experiment 1
- Presentation: C. Landsberg, (2017, March 01). Presentation of poster at Section 219 Technical Exchange Meeting at Caderock Bethesda, MD.
- Collaborative Mechanism: C. Landsberg, (2017, March 08). IRB approval
- Workforce Development (Training):
 - Multilevel Theory, Research and Analysis Workshop. (2017, April 12 - 2017, April 14). Florida Institute of Technology. Orlando, FL. Attended by 2 team members.
 - Generalized Intelligent Framework for Tutoring Summer Camp. (2017, June 07 - 2017, June 08). Army Research Lab. Orlando, FL. Attended by 2 team members.

INVESTIGATING LOW-COST UNTETHERED VIRTUAL REALITY TECHNOLOGIES AND THE ROLE OF AFFORDANCES ON TRAINING EFFECTIVENESS IN AN IMMERSIVE ENVIRONMENT

PROJECT DURATION

OCT 2014 - SEP 2018

OBJECTIVE

1. Investigate and evaluate the feasibility and limitations of emerging, low cost, COTS, 3D VR-based technologies for training systems.
2. Examine whether some of the affordances of an immersive VR environment enhance performance.
3. Investigate safety and alignment issues associated with mixed reality.

VALUE TO THE WARFIGHTER

The results can impact future applications of VR to training system design, performance aiding tools, and follow-on VR research. The results will help inform the optimization of VR technology usage, and provide information useful in determining why specific types of training are beneficial.

FUNDING SPONSOR

Naval Air Systems Command (NAVAIR) | Section 219

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User in Prototype Testbed using Virtual Reality (VR) Headset

DESCRIPTION

- Investigated and evaluated the feasibility and limitations of emerging, low cost commercial-off-the-shelf (COTS) 3D immersive technologies (e.g., virtual reality [VR] head-mounted displays [HMDs], camera-based tracking, and low cost game engines) to provide practical and effective virtual reality information delivery within a training and/or performance aiding context.
- Built testbed using existing E-28 maintenance software in conjunction with Oculus Rift VR HMD and Microsoft Kinect cameras.
- Conducted Experiment #1, investigating gesture affordances.
- Built testbed using HTC Vive VR HMD. Designed and executing Experiment #2 on mixed reality and feedback.

NEED

VR training solutions have the potential to reduce training cost, maximize training impact, and maximize transfer of knowledge from the

classroom to the operational environment. The exploration of low cost VR alternative technologies will help to inform designs and uses of VR technologies that may lead to adding VR to areas previously limited by program budgets. This work will help the NAE remain at the front of applied S&T understanding on how best to make use of the technology.

BENEFITS

Expand the research on best practices for improving learning in VR. Experiment 1 examines: a) whether VR is more effective for training procedures than desktop-based training, and b) different methods interacting within VR (gesture-based vs. voice-based interactions). Experiment 2 explores different methods of providing feedback in VR.

STATUS

The project is entering its final year. The second experiment is underway. The results will be collected, analyzed, and reported by the end of FY18.

KEY ACCOMPLISHMENTS

- Experiment 1 wrap-up: Present research at Psychonomics and I/ITSEC conferences
- Complete Experiment 2
 - Complete data collection
 - Analyze data
 - Write up results for conference submission to the Human-Computer Interaction International Conference (HCII)
- Planned submission of journal manuscript to *Journal of Experimental Psychology: Applied*
- Planned paper on Experiment 2 results, HCII proceedings

INVESTIGATION OF MICRO-ADAPTATION SCHEDULES TO SUPPORT ELECTRONIC SUPPORT MEASURES OPERATOR ADAPTIVE TRAINING



Simulated Real-time Displays

DESCRIPTION

Previous research has shown that including Adaptive Training (AT) techniques to a domain trainer is more effective than its non-adaptive counterpart. However, there are still research questions yet to be answered that may further increase the effectiveness of AT. In this effort we are comparing within- and between-scenario difficulty algorithms to determine if increasing the rate of difficulty adaptation will lead to more efficient and effective learning outcomes. Adapting immediately, within a scenario, based on in-situ performance should keep the trainee in their Zone of Proximal Development (ZPD) and quickly adapt if a student falls out of their ZPD.

NEED

AT was highlighted as a priority in the Submarine Training Requirements Group letter. AT has also been identified as a solution for COMSUBPAC to satisfy the CNO's High Velocity Learning request. Additionally, AT is in line with ONR's Science and Technology (S&T) Strategy for Warfighter Performance which indicates a need for sailors to receive tailored training.

BENEFITS

Current efforts under Scalable, Integrated RF Systems for Undersea Platforms (SIRFSUP) TACAID are addressing on-board training needs in the ESM community by using an Adaptive Training solution. The current effort will provide data to guide adaptation schedule decisions for the SIRFSUP effort in order to develop the most cost-effective and efficient method of adaptation for ESM operator training.

STATUS

During the first year of the project, the team has designed an experiment comparing within- and between-scenario difficulty adaptation schedules, as well as a control condition, for a submarine ESM inspired task. The team has also created a graphic user interface that will be used to collect task reports from participants and adapt the training scenarios. Several individual difference measures will also be collected. During the current fiscal year, the team will begin piloting the experiment prior to collecting data from UCF students.

PROJECT DURATION

DEC 2016 - DEC 2018

OBJECTIVE

This project aims to compare different difficulty adaptation schedules within an Adaptive Training (AT) system in an effort to determine the most efficient and effective way to employ AT algorithms within a submarine Electronic Support Measures Operator Domain.

VALUE TO THE WARFIGHTER

One-on-one tutoring is often considered the gold standard for training and education, partially because tutors can flexibly adapt to their student's needs on the fly. However, one-on-one tutoring is not a tenable solution for training in the real-world due to costs and manpower, and AT is a cost-effective solution that leverages some of the benefits of one-on-one tutoring.

FUNDING SPONSOR

Office of Naval Research (ONR)

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KEY ACCOMPLISHMENTS

- Received Institutional Review Board (IRB) Approval.
- Mentoring of two University of Central Florida Human Factors PhD students.
- Created GUI to collect task performance data on ESM inspired task.
- Developed an adaptive engine that assesses and adapts difficulty after each point of assessment.

LEARNING CONTINUUM AND PERFORMANCE AID (LCaPA)

PROJECT DURATION

NEW START
OCT 2017 - SEP 2021

OBJECTIVE

The objective of this effort is to develop methods to accelerate learning, minimize atrophy, and provide on-the-job performance support that improves individual Sailor performance and enhances mission readiness. This will significantly reduce the cost and time for getting training to the Fleet and increase the Navy's agility in a rapidly changing world.

VALUE TO THE WARFIGHTER

LCaPA will deliver a non-proprietary collection of flexible interoperable applications that support an individualized learning continuum capable of capturing a Sailor's ability that allows performance feedback, remediation, job aiding, and data retrieval services that can be used for career management, skill classification, training, supervisor evaluation, and Fleet readiness tracking.

FUNDING SPONSOR

Office of Naval Research (ONR)

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PAL3 in use

DESCRIPTION

LCaPA seeks to develop a non-proprietary collection of flexible applications that provides:

- Personalized Guided Study
- Adapting to Skill Decay
- Learner Models
- Mobile Learning
- Ubiquitous Learning
- Virtual Agent Relationship
- Social Motivation
- Persistent Learner Record
- Reuse of existing high-quality resources
- Training Effectiveness Evaluations
- Capturing Sailor's experience
- Intelligent System Updating

NEED

Today Sailors typically attend school and receive most of their rate-specific training up front, which can last up to two years. By the time they reach their assignments their skills could have atrophied or the technology they trained on has become outdated. As part of

Sailor 2025, the Navy wants to provide "Ready, Relevant Training" to the Fleet, which will provide a career-long learning continuum where training is delivered at multiple points throughout a career by modern delivery methods to enable faster learning and better knowledge retention.

BENEFITS

LCaPA will help the Navy transform their industrial, conveyor belt training model. Sailors will receive modernized content through multiple delivery options to accelerate learning, minimize atrophy, and provide on-the-job performance support that improves individual performance, and enhances mission readiness. This will significantly reduce the cost and time for getting the training to the Fleet, increasing agility in the Navy's rapidly changing world.

STATUS

This effort is a new start for Fiscal Year 2018. For this fiscal year industry partners will be selected for the overall program based on their expertise and program needs.

GOALS FOR FY18

- Conduct data collection on Aviation Electrician Rate
- Investigate and develop initial skill decay curves

MISHAP AWARENESS SCENARIOS AND TRAINING FOR OPERATIONAL READINESS RESPONSES



Aviation survival training seeks to advance mishap awareness training through interactive, immersive visualization techniques such as moderate fidelity training systems.

DESCRIPTION

Advances in virtual reality and computer graphics make it possible to create a software program that allows the user to set a scenario based off of mishap data to recreate mishap events for training leveraging a range of media. The Navy seeks a single scenario development technology that provides inputs to develop a range of training opportunities that are consistent and require minimal investment by the program to continue to expand mishap training scenarios. This system should allow for the development of new scenarios, as well as provide an ability to modify previously created scenarios within the tool through a simplified user interface.

NEED

Spatial disorientation (SD) and situational awareness (SA) are significant contributing factors to the majority of aviation mishap events. The aviation survival training community has requirements to provide sensory physiology/situation awareness training; however, the current training is predominantly classroom based instruction that leverages videos which are not easily updated as new platforms or situations occur.

BENEFITS

Providing a more immersive range of training opportunities will allow for more trainee experience and engagement and likely improve the fidelity and appropriateness of the training. Operator performance will also increase through the ability to better recognize and/or implement emergency procedures when experiencing SD/SA situations, creating safer and more effective warfighter operations.

STATUS

This SBIR has undergone competitive source selection to award Phase I. The selected 4 contractors will spend Phase I conducting feasibility analyses and designing/developing prototypes. The awarded industry partners will participate in initial kick-off meetings with the government stakeholders in October-November 2017 to discuss Phase I plans.

PROJECT DURATION

★ NEW START ★
SEP 2017 - SEP 2020

OBJECTIVE

Develop a customizable software program that provides outputs to result in a suite of training tools and technologies that supports recreation of aviation mishap events to convey lessons learned and improve safety training through classroom based videos and interactive, immersive visualization techniques.

VALUE TO THE WARFIGHTER

This project will provide the warfighter with a more immersive range of training opportunities that are grounded in consistent data across multiple platforms. Training will be improved through capabilities that will allow aviators the ability to better recognize and/or implement emergency procedures when experiencing spatial disorientation and situation awareness situations.

FUNDING SPONSOR

Naval Air Systems Command
(NAVAIR)

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GOALS FOR FY18

- Project Kick-off meetings
- Complete Phase I feasibility analysis
- Down select to 1 or 2 awardees

POST MISSION ASSESSMENT FOR TACTICAL TRAINING & TREND ANALYSIS (PMATT-TA)

PROJECT DURATION

OCT 2010 - SEP 2020

OBJECTIVE

PMATT-TA seeks to increase training effectiveness and efficiency with improved capabilities for post mission reporting and trend analysis, while reducing operational costs.

VALUE TO THE WARFIGHTER

PMATT-TA allows for a reduction of manual data entry and analysis to increase data reliability, and provides a centralized tool that supports accurately gauging overall fleet readiness at a competency-based level and the delivery of targeted training. Tools delivered to simulation training include automated, system-based performance measures to increase instructor consistency and diagnostic feedback.

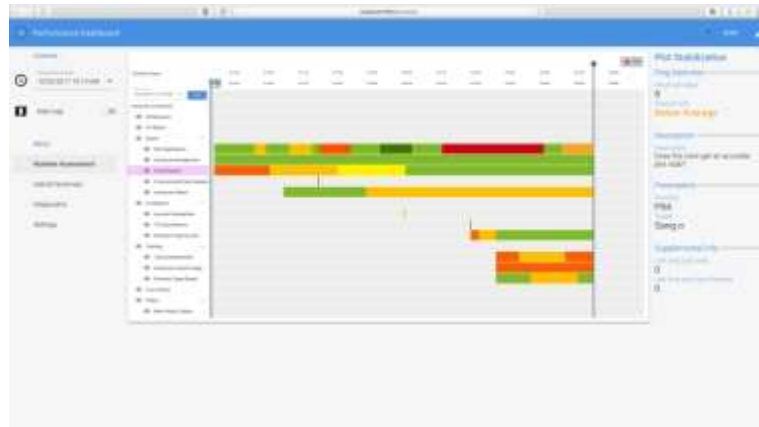
FUNDING SPONSORS

Naval Aviation Training Systems
Program Office (Program
Management Activity [PMA] 205);
PMA-290;
Naval Air Systems Command
(NAVAIR);
NAVAIR | Section 219;
Office of Naval Research (ONR)

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The PMATT-TA Increment 2 instructor interface provides a timeline display with quick access to automated, system-based performance measurement results.

DESCRIPTION

PMATT-TA targets research, development and implementation of a centralized, readiness data archival and analysis system via an incremental transition. Increment 1 focused on development of a SIPR-based web application and underlying database, while Increment 2 focuses on integration of increased automation including system-based performance measures.

NEED

A Statement of Urgent Need (CPRG, JUN 2010) highlighted the lack of existing Navy products to support force-wide Anti-Submarine Warfare training assessment. The call cited the lack of centralized performance data as the key limiting factor that needed to be addressed with objective, outcome-based performance data to understand aircrew performance based on measures that provide force-wide tactical proficiency and support targeted remediation via training solutions.

BENEFITS

PMATT-TA allows for a reduction in time spent entering data manually, which will save time, money, and effort. This also allows for increased reliability in data, which is important when considering the magnitude of the decisions made using such data. PMATT-TA will also assist stakeholders in accurately gauging fleet readiness and competencies in a streamlined and easy-to-use way, providing a novel technology to view trends in training and performance, ultimately allowing for more informed decision making.

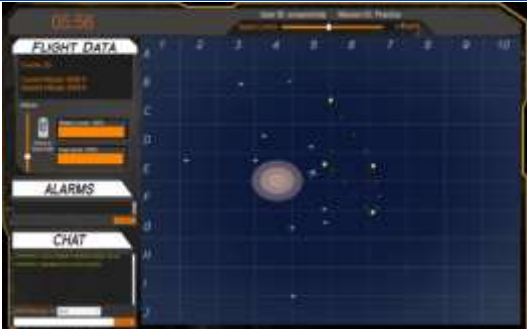
STATUS

PMATT-TA Increment 1 is currently hosted on SIPR and used by CPRW-10, CPRW-11, and CTF7.2. There is a transition plan for CTF-6.7 in development. Iterative testing is performed on PMATT-TA both by the development team as well as by research psychologists who routinely change and update the web-based software based on fleet feedback. PMATT-TA Increment 2 has undergone iterative testing within the Boeing P-8 Weapons Tactics Trainer (WTT) in preparation for implementation in upcoming software releases (TSR-13, FEB 2018).

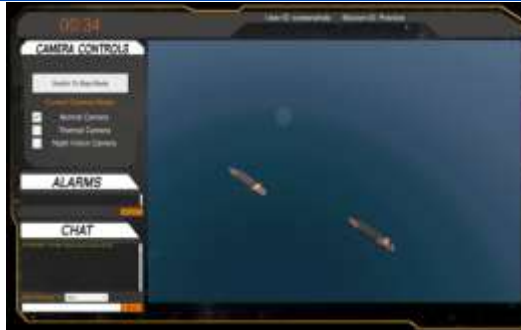
KEY ACCOMPLISHMENTS

- Manuscripts/Publications: Atkinson, Tindall, Killilea, Tolland, & Dean. (2017). Standardizing human performance measurement for ease of data analytics. Proceedings of the IITSEC.
- Presentations:
 - Government Colloquium. B. Atkinson, (2017). Post Mission Assessment for Tactical Training & Trend Analysis. Maritime Patrol Reconnaissance Weapons School; Environmental Working Group.
 - Demonstration exhibit at IITSEC 2017.
- Workforce Development: Mentored junior teammates on program management, interaction for transition, usability analyses, and coordination with fleet customers.
- Transitions:
 - Deployment of PMATT-TA Increment 1 to CTF-7.2 (MAR-APR 2017) and plan in development for CTF-6.7 (Spring 2018).
 - Transition of PMATT-TA Increment 2 technology to PMA-290 with APN funding (FY18).

RESEARCH EXPLORING MULTI-OPERATOR TRAINING ENVIRONMENTS (REMOTE)



Left: REMOTE Air Vehicle Operator (AVO) Console.



Right: REMOTE Sensor Operator (SO) Console.

DESCRIPTION

Game engines offer a multitude of options for connecting multiple users/players to a shared environment, passing state and user information to/from those users, and managing networked performance. Many of these solutions have varying software requirements, cost ranges, caps on numbers of users, and performance values. This effort allowed NAWCTSD scientist and engineers to understand these technologies and perform hands-on testing to determine which solution(s) best fits the training model for the Navy. The team researched and tested several solution sets and then implement one into the research test bed for a cross training study.

NEED

This effort supports the 2013 NAVAIR Core Capabilities Human Systems (4.6) Capability 3. That is, it supports the development of Virtual Environments and Training Technologies. Additionally, this effort supports the Naval Warrior Performance Science Technology Objective 1: Training and Education. Lastly, this effort supports the Department of the Navy Science and Technology Warfighter Performance focus area as well as the Manpower, Personnel, Training and Education focus area.

BENEFITS

The effort provided NAWCTSD with a 3D MUVE testbed with reusable content and resources for future Unmanned Aviation System (UAS) team and multi-team efforts. Additionally, this effort provided the research team with first-hand knowledge of the current state-of-the art in gaming technologies and multi user virtual environments. This valuable experience will be leveraged in future MUVE research efforts.

STATUS

This effort was completed in fiscal year 2017. The MUVE UAS proof of concept developed in fiscal year 2016 was finalized in fiscal year 2017 and delivered to the human performance team to conduct a UAS cross-training team study. The UAS MUVE is the simulation virtual environment for the study. Data collection, with participants from the local community, and data analyses were completed within the fiscal year. A journal manuscript describing the results of the cross-training study was completed. Additionally, an overview of the effort was presented in a panel presentation at the 2017 International Symposium on Aviation Psychology.

PROJECT DURATION
MAY 2014 - SEP 2017

OBJECTIVE

The US Navy is currently moving from individualized stove-piped training to more team and multi-team training. However, at the Naval Air Warfare Center Training Systems Division (NAWCTSD) our scientist and engineers do not have, or have limited access to, multi user research test-beds to conduct this research and test out concepts. The objective of this effort was to develop a 3-dimensional immersive Multi User Virtual Environment that can be used to enable future research projects.

VALUE TO THE WARFIGHTER

This effort is a first attempt to develop, using game engine technologies, a multi user testbed to enable future team and multi-team research projects at NAWCTSD.

FUNDING SPONSOR

Naval Air Systems Command
(NAVAIR) | Section 219

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KEY ACCOMPLISHMENTS

- 3D Multiuser Virtual Environment Capability was delivered to AIR 4.6.5.1
- Training: College of Research & Engineering (CORE)-465-227: Multilevel Theory, Research & Analysis. (2017, April 12 - 2017, April 14). NAWCTSD. Orlando, FL. Attended by R. Astwood, Jr. & A. Mercado.
- STEM Outreach: Naval Research Enterprise Internship Program (NREIP) intern selected to work on this effort. (2017, June 05 - 2017, August 11). University of Central Florida.
- Institutional Review Board: R. Astwood, (2017, January 31). IRB approval TSD 226: Research Exploring Multi Operator Training Environments (REMOTE).
- Professional Society Presentation: Ms. G. Severe-Valsaint, (2017, May 08). Research Exploring Multi-Operator Training Environments. 19th International Symposium on Aviation Psychology-Dayton, Ohio.
- Paper publication in preparation: *Research Exploring the Influence of Cross-Training in Multi-Operator Environments*.
- Cross-competency collaboration between AIR 4.6.5 and 4.6.2.

SEXUAL ASSAULT PREVENTION AND RESPONSE (SAPR) VIRTUAL IMMERSIVE TRAINING

PROJECT DURATION JAN 2016 - SEP 2019

OBJECTIVE

To create training that will prepare Marine Corps and Navy Officers and Senior Enlisted personnel for their respective roles and responsibilities in preventing and responding to sexual assault. This is in addition to the sexual assault prevention training provided to all personnel through required annual GMT and is specific to the responsibilities of an Officer or Senior Enlisted member.

VALUE TO THE WARFIGHTER

No form of sexual assault is tolerated in the U.S. Navy or Marine Corps, and it is imperative that senior and mid-level personnel understand how the prevention and response program is to be administered. Training to prevent sexual assault and the correct response if an assault should occur is required by law and will aid in providing recovery for the victim.

FUNDING SPONSOR

Department of the Navy (DON),
Sexual Assault Prevention and
Response (SAPR) Office

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SAPR Officer and Senior Enlisted Interactive Training Environment

DESCRIPTION

This effort aims to create an online/web-based virtual immersive training that includes the development of course goals, learning objectives, curriculum, interactive knowledge assessments, reference materials, and adaptive training scenarios.

NEED

Sexual assault is devastating to victims and can greatly impact a Unit's mission readiness and effectiveness. It is imperative that Navy senior and mid-level managers understand the Marine Corps and Navy program for prevention and response, and their responsibilities.

Requirements: Department of Defense
Instruction 6495.02 & SECNAVINST 1752.4B

BENEFITS

The Marine Corps and Navy's Sexual Assault Prevention and Response program is complex, including aspects required by law. In order to administer the program correctly and ensure protection for the victim and the accused, the proper conduct of an investigation, the preservation of evidence, the roles of assisting personnel (victim advocates, legal, investigative, and medical) and sexual assault response services are performed precisely, Navy and Marine Corps Officers and Senior Enlisted must understand their responsibilities if an assault should occur. The training developed from this effort will ensure that the Marine Corps and Navy program is correctly managed.

STATUS

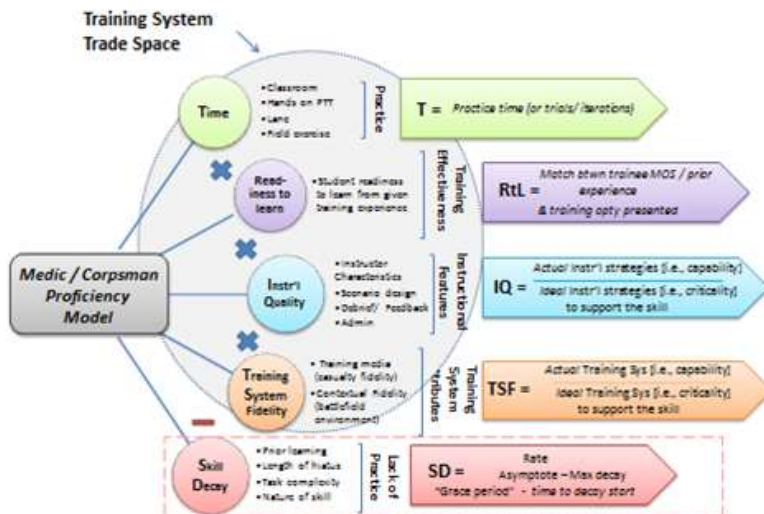
The Marine Corps Sexual Assault Prevention and Response course curriculum, interactive training scenarios, and assessments were delivered to the Marine Corps SAPRO office in FY16.

The Navy Sexual Assault Prevention and Response course curriculum, interactive training scenarios, and testing materials, are in development and will be completed by December 2017. Creation of the web-based virtually immersive portion of this effort will begin in FY-19, with completion expected by September.

KEY ACCOMPLISHMENTS

- The Navy-centric portion of this effort began in Aug 2017. No major accomplishments in FY17.
- **Transition:** The sexual assault prevention and response training materials for the Marine Corps Field Grade Officers, Staff Officers and Noncommissioned Officers were completed in FY16. The course curriculum, learning objectives, interactive training scenarios and assessment materials were developed and delivered to the Marine Corps Sexual Assault and Prevention Office.

SYSTEMATIC TEAM ASSESSMENT OF READINESS TRAINING (START) APPLIED TO MEDIC/CORPSMAN PROFICIENCY MODEL (MED-PM)



Med-PM proficiency model and trades space.

DESCRIPTION

The Med-PM project is a phase 2 effort that builds upon and extends prior and concurrent DoD and DHA funded work. A model of Combat Medic/Corpsman proficiency is being built leveraging heavily from NAWCTSD's Navy Aviation Proficiency Model. The medical proficiency model is at the core of a trade space analysis tool representing learner and training system factors over which trainers and acquisition stakeholder have influence. An analysis and visualization suite will allow stakeholders to analyze current and notional training configurations and the resulting impact on proficiency, and generate results in graphics designed specifically to facilitate communication of complex information.

NEED

Training initiatives such as Tactical Combat Casualty Care (TCCC) have made a tremendous difference in preparing medical providers to save lives on the battlefield. Conflict exists however, over those medical skills training approaches that include animal simulation. Increasing pressure from advocacy groups to eliminate live tissue training gives rise to the need for modeling and analysis methods to examine the impact of alternative training approaches on medical skills development.

BENEFITS

From an applied perspective, the medical proficiency model and trade space analysis tool will optimize training and acquisition decisions; and from a research and development perspective, identify gaps in applied learning science.

More specifically, Med-PM will identify strengths and gaps in existing TCCC training programs related to time to train, training system fidelity (media and environment), instructional capabilities and student readiness to learn; and allow decision makers to make informed investments related to curricula changes and / or technologies.

STATUS

The project is entering Year 2, during which:

- a skill acquisition and retention framework will be refined to improve model algorithms (proficiency acquisition and skill decay for different task and learner types).
- the model will be instantiated in a software tool with an intuitive user interface including a training system health dashboard.
- a pilot experiment will be conducted. TCCC course will be modeled and compared to learning requirements.

PROJECT DURATION
OCT 2016 - SEP 2018

OBJECTIVE

To develop a medical skills proficiency model and training trades space analysis tool yielding decision quality results for training and acquisition stakeholders. The tool will provide diagnostics of the health or capability of the system to produce proficient learners; 'what if-ing' of alternative training system configurations considering the impact on proficiency attainment; and present outputs - training requirements and training system health metrics - in intuitive visualizations.

VALUE TO THE WARFIGHTER

More effective, efficient medical skills training. The proficiency focused trade space analysis tool will provide training and acquisition communities with information on which to make informed decisions regarding training system configurations that will optimize warfighter proficiency acquisition.

FUNDING SPONSOR

Defense Health Agency (DHA) / Joint Program Committee (JPC) -1

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KEY ACCOMPLISHMENTS

- Awarded 3 contracts to support:
 - Skill Acquisition and Retention Framework enhancement
 - Med-PM trade space analysis tool development
 - Training opt venue modeling

TEAM-BASED ADVANCED RESILIENCE ACCELERATOR (TARA)

PROJECT DURATION

NEW START
SEP 2017 - SEP 2019

OBJECTIVE

Develop a prototype system called Team-based Advanced Resilience Accelerator (TARA) for unobtrusively and objectively measuring teamwork and team resilience behaviors. In addition to measuring performance, TARA will also provide descriptive and prescriptive feedback to training instructors to aid them in providing feedback, developing an After Action Review, and providing recommendations for training scenario adaptation to target areas of weakness within the team.

VALUE TO THE WARFIGHTER

The TARA system will provide tools for assessing team performance and providing training recommendations that will assist instructors in maximizing training time and value. These assessments will be objective and unobtrusive, while also reducing the administrative burden on the instructor. This will enhance training effectiveness and efficiency and reduce instructor load.

FUNDING SPONSOR

Naval Aviation Training Systems
Program Office (Program
Management Activity [PMA] 205)

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TARA system concept

DESCRIPTION

The proposed research and development effort will expand on existing solutions to develop TARA, a team behavior measurement and feedback system that will support coaching, mentoring, and training of team skills. Ultimately, TARA will support performance assessments over time to allow instructors and teams to discover the deep connections that exist between their actions, the task conditions, and outcomes, which will provide them with the foundation they need to act and make intuitive decisions. The assessment tool can benefit the instructor and the trainee in understanding a team's strengths and weaknesses and to use this knowledge to select the optimal training path for the team.

NEED

NAE Science & Technology Objective Alignment: 10. Naval Warfighter Performance (NWP) Capability Gap (10.1 NWP STO-1: Training and Education)

Submarine Learning Center has a need for an improved team performance assessment capability and provided a letter of support for this effort.

Team-based Advanced Resilience Accelerator will result in the accelerated development of resilient team skills that are needed in order for the team to perform effectively and efficiently when on duty. Performance assessment and targeted/adaptive training is needed to accelerate these skills, but instructors are already overworked in these environments, so providing tools to assist the instructor are needed and will be provided by TARA.

BENEFITS

The proposed work will benefit the Submarine Force by providing advanced resilience training to tactical teams at all five levels of their training practices including: Formal Schools, Formal Qualification, Continuing Training, Inspection and Certifications, and Self-Assessment. These teams will be better equipped with recognizing danger and to seize the opportunity in times of uncertainty, as well as being able to adapt to changing situations. This effort aims to improve the effectiveness and efficiency of the training by increasing the quality of the assessments in order to provide a tailored training experience and potentially reducing training time by excluding activities that have been mastered.

STATUS

The Contract for this effort was awarded on September 19, 2017. The project kickoff will take place in November 2017. The remainder of the fiscal year will focus on identifying individual and team measurement constructs and development of team measures and communication signals to include in the TARA tool. The last quarter of the year will involve collection of communications data and expert observations in the training environment to test out the proposed measures.

GOALS FOR FY18

FY18 Deliverables:

1. Kick-off Meeting Presentation and Slides
2. Quarterly Government Progress Reports
3. Yearly Progress Review Presentation and Slides

MAINTAINER-PROFICIENCY MODEL (MAIN-PM)



Lab-based practice for basic wiring skills. The amount and quality of such practice are considered in the PPT for proficiency predictions.

DESCRIPTION

There are three main elements to the development of the aviator maintainer proficiency model. The first is to develop a “performance model” to characterize a maintainer’s job (CH-53E wire repair is the domain selected for study), that includes tasks; knowledge, skills and attitudes; and a logical sequence of proficiency progression. The second is to integrate the performance model with learning science to develop a proficiency prediction tool (PPT) based on quality assessments of instructional content and practice. The third element encompasses efforts to refine and validate the PPT (e.g., tool tryouts, compare PPT predictions of proficiency gains to actual proficiency gains).

NEED

The work performed for this effort supports the Advanced Training Systems Technology core competency. The results will also contribute to NAWCTSD’s proficiency tool suite to better enable diagnostic training program assessment.

BENEFITS

The proposed effort will help break down scientific barriers that innovative training initiatives such as Sailor 2025 will face. For

example, Sailor 2025 proposes to place more training on ships, but existing technological infrastructures present barriers to insertion of these technologies. Two of the proposed proficiency model quality constructs, media/training context fidelity and instructional quality, will enable tradeoffs and comparisons to be made. That is, given the technological infrastructure, the question could be answered: which training technologies are best suited for insertion, and what will the tradeoffs be in terms of the skills that can be trained.

STATUS

In FY17, the performance model and PPT were developed. In FY18, a performance assessment suite (PAS) will be developed and administered in conjunction with the PPT during CH-53E accession training and at key career milestones. These data will be used to inform the proficiency model in ways that include: support preliminary validation of the PPT, estimate skill decay, and baseline performance. The team will work with stakeholders to identify implications of the data and COAs produced by the tool for training-related mitigations of the RBA gap.

PROJECT DURATION OCT 2016 - OCT 2017

OBJECTIVE

The objective of this work is to develop a model of maintainer proficiency, based on learning theory and empirical data, that can be used to identify, understand, and mitigate training shortfalls that contribute to the Ready Basic Aircraft (RBA) gap; and support decision quality analysis of training courses of action (COAs) in which variables such as time to train, training device features, and training sequence are manipulated.

VALUE TO THE WARFIGHTER

The results of this research can be used to enhance readiness because it addresses maintainer training, a known contributor to the existing Ready Basic Aircraft (RBA) gap.

FUNDING SPONSOR

Naval Air Systems Command
(NAVAIR) | Section 219

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KEY ACCOMPLISHMENTS

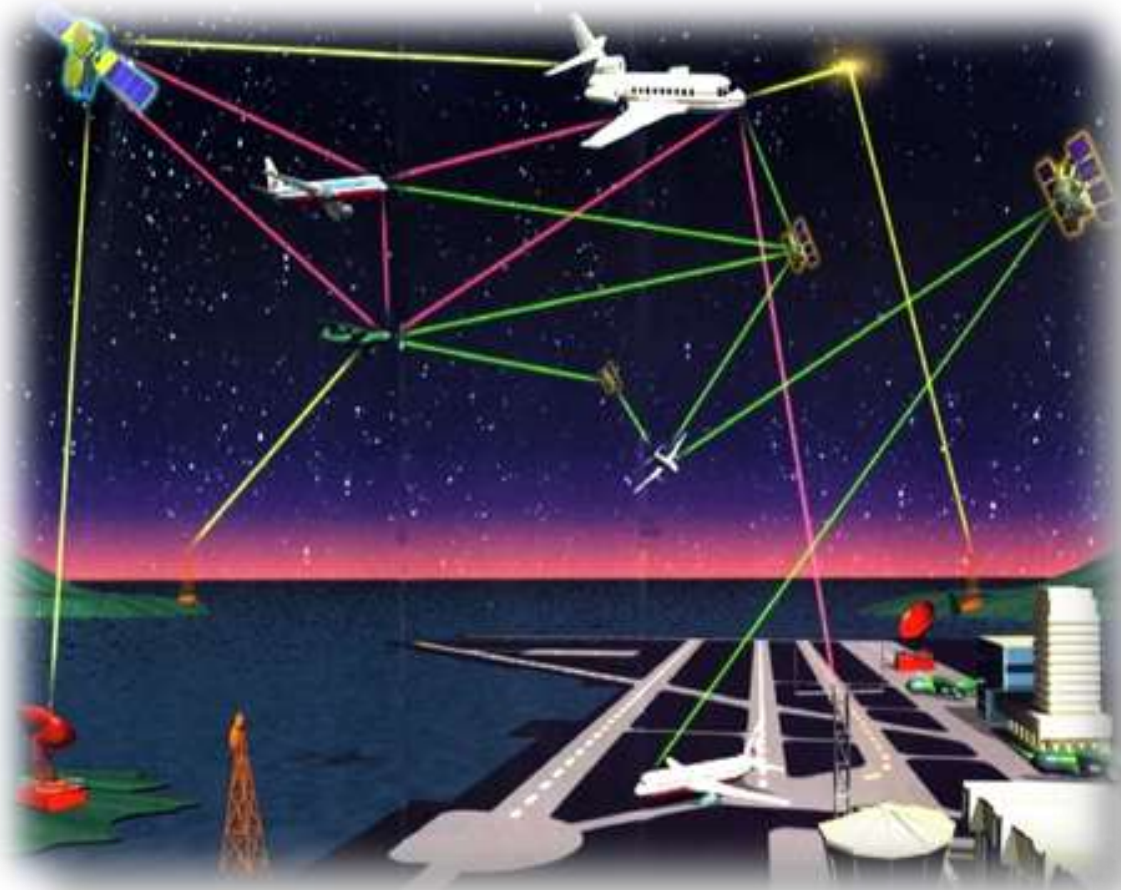
- In-progress patent application: Ms. T. Siders, (2017, September 29). Military Maintenance Training based on a Proficiency Learning Progression, Media Mapping, and Crowdsourcing.
- In preparation: J. Fowlkes, T. Siders, K. Neville, (2017, September 29). Prioritized Task Treatments - Linking Learning Science to Media Selection. Refereed.

CORE CAPABILITY 3: ADVANCED TRAINING SYSTEMS TECHNOLOGY

Training systems, such as LVC simulations, provide an appropriate mix of environments where learners can interact in real time with each other using networked devices. Technology can augment warfighter preparedness by providing training opportunities that might not be available due to factors such as cost, safety, and resource availability. Training technology includes the ability to provide realistic rendering and modeling, multisensory input/output devices (e.g., visual/audio/haptic displays, speech recognition, and flight control sticks), and system interconnectivity such as web servers, networking bandwidth, and processing speed).

The following Technology areas comprise this Core Capability:

- High-Fidelity Training Environments
- Simulation Interoperability and Distributed LVC Technology



3D INTERACTIVE AIRCRAFT CARRIER OPERATIONS TRAINING TOOL



Main Menu of 3D Carrier Operations Training Tool - can create an air plan or new spot.

DESCRIPTION

FY16: Developed a 3D Aircraft Carrier Operations Training Planning Tool prototype for Planning mode

FY17: 1) Added Operations mode and finalized prototype, 2) Conducted heuristic evaluation and comparison of the prototype to the existing Ouija board planning tool

FY18: Transition the product as a training tool to the Center for Naval Aviation Technical Training (CNATT).

NEED

There is currently no training tool that teaches the Aviation Boatswain's Mates, Handlers (ABHs), the flow of aircraft on deck, or the cause and effect relationship between the aircraft spot and execution of the air plan. They only receive on-the-job training (OJT) as they rotate through various positions.

BENEFITS

This training tool would fill the critical training gap by allowing ABHs to understand the flow and cadence of aircraft during operations and train them how the initial spot of those aircraft on deck affects operations throughout the day. This tool would also allow for training of abnormal and emergency conditions aboard ship, which is currently a capability that does not exist.

STATUS

The project is entering its final year. The project will result in a technology transition of the training/software planning tool to CNATT in FY18.

PROJECT DURATION
OCT 2015 - SEP 2018

OBJECTIVE

Current 2D Aircraft Carrier Planning Tools (ADMACS Digital Ouija Board and the Traditional Ouija Board) have several limitations for planning and training. These current toolsets do not allow the crew to visualize danger areas or planning issues. The tools also do not allow the aircraft spot to be simulated or checked for errors. The research from the effort investigated solving these issues using the newest 3D game engine tools for design and simulation.

VALUE TO THE WARFIGHTER

Aviation Boatswain's Mates, Handling (ABHs) have limited opportunities to develop the skills and knowledge required for their positions. These positions follow the traditional on-the-job training (OJT) Personnel Qualification Standards (PQS). Virtual training opportunities have the potential to shorten the PQS timeline through advanced familiarization, thereby improving efficiency.

FUNDING SPONSOR

Naval Air Systems Command
(NAVAIR) | Section 219

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Different views of the 3D Carrier Operations Training Tool's functionality

KEY ACCOMPLISHMENTS

- Completed training tool software and technology transition to CNATT.

COURSE RULES PART TASK TRAINER STUDY

PROJECT DURATION

* NEW START *
OCT 2017 - JUN 2018

OBJECTIVE

The objective is to conduct a training effectiveness evaluation of the Virtual Reality (VR) course rules trainer; primarily focused on comparing the effectiveness of a contractor's part task trainer to that of the existing course rules training.

VALUE TO THE WARFIGHTER

If the part task trainer is effective, there is the possibility of using the part task trainer in lieu of some actual flight time.

FUNDING SPONSOR

Naval Aviation Training Systems
Program Office (Program
Management Activity [PMA] 205)

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T-45 Goshawk training aircraft.

DESCRIPTION

A quasi-experimental training effectiveness evaluation for the VR course rules part task trainer, comparing learning outcomes between a treatment group of naval flight students trained on the contractor's device(s) and a control group comprised of naval flight students who learn course rules using existing materials. Course rules mastery will be evaluated using self-report knowledge ratings provided by student aviators and knowledge assessments by flight instructors observing participating students. Mastery reports may be captured using an online survey tool.

NEED

The navy has a need to train aviators for second and third familiarization flights and Aechelon's VR part task trainer is a candidate to replace existing course rules training methods.

BENEFITS

If effective, the Navy could replace some in air training with new part task trainer. Also, this study has the opportunity to show VR being used effectively in a training environment.

STATUS

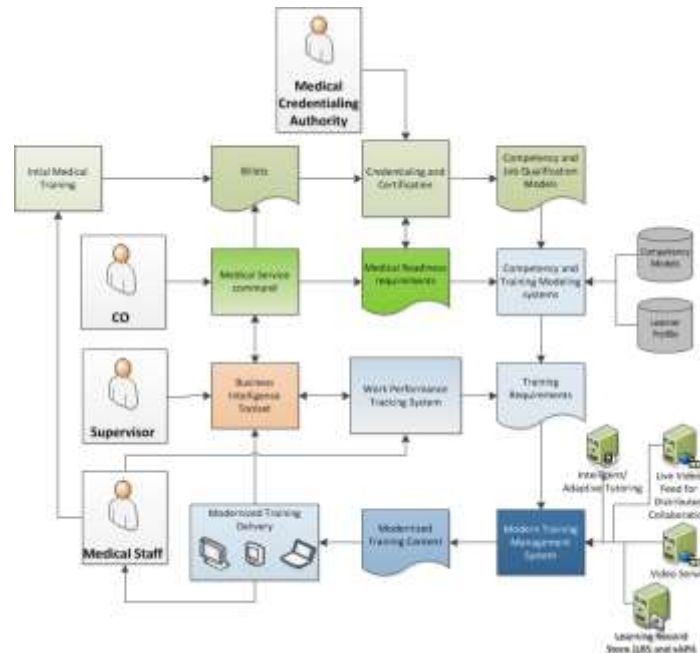
This project kicked off the second week in October and has a 6 month period of performance.

GOAL FOR FY 2018

- Complete experimental training effectiveness evaluation of the virtual reality course rules trainer.

DEFENSE HEALTH AGENCY (DHA) TOTAL LEARNING ARCHITECTURE (TLA) LEARNING TECHNOLOGY ROADMAP WITH CONCEPT PILOTS

Systems view of the proposed Defense Health Agency Total Learning Architecture. This view shows the content and data flow from staff training to work performance enabling adaptive training, modern learning technologies, and "right place, right time" access to training.



DESCRIPTION

NAWCTSD's Modern Learning Strategies (MLS) team, with academic and industry partners, will develop the technology roadmap necessary to enable a TLA. The roadmap will document current medical learning environments needed and in use, as well as the instructional methods, systems, and infrastructures required by the conceptual TLA. The team will work with DHA to identify existing instructional courses that would be appropriate to use as the basis for TLA pilots. The scope of the current effort includes execution of two instructional course pilot efforts.

NEED

A TLA is a critical enabler for the effective structure and organization of training continua. Without it, mechanisms for evaluating curriculum structure and learning effectiveness are either absent or piecemeal efforts. A TLA is needed to provide visibility across the training continuum. The TLA cannot be achieved without prerequisite analyses of the state of training, a technology roadmap, and pilot programs for development and evaluation.

BENEFITS

Development and transition of a TLA roadmap will help ensure that curricula are yielding effective learning, and structured to optimize resources of time, materials, and funding. This will include not only pedagogical evaluation to

ensure that content is structured to maximize learning, but also information assurance, systems interoperability, and courseware and content delivery requirements across training media and information systems. The supported TLA will be a critical enabler of training delivery, optimized structure, and effectiveness evaluation.

STATUS

This is a new effort, kicking off in early FY18.

- Phase I will consist of analysis and initial investigation for the development of a DHA Learning Technology Roadmap to be delivered in outline form.
- Phase II will see delivery of iterations and a finalized DHA Learning Technology Roadmap.
- Phase III will see the TLA Pilot courses authored during phase one executed.

KEY ACCOMPLISHMENTS

- DHA leadership has accepted and approved the effort
- Funding strategy has been identified
- NAWCTSD Team members identified

PROJECT DURATION

NEW START
NOV 2017 - APR 2019

OBJECTIVE

The goal of the effort is to begin the ambitious task of moving the DHA community to a holistic learning architecture. The Total Learning Architecture (TLA) will attempt to define DHA's unique learning needs, strategies to present them, and mechanisms to deliver them.

VALUE TO THE WARFIGHTER

DHA VADM Bono has asked how we can verify what we are teaching is actually being learned. This TLA is a critical first step toward answering this question, and will support the establishment of a learner centric learning environment that will make it possible to identify learning needs and validate learning success.

FUNDING SPONSOR

Defense Health Agency (DHA) - Research and Development (J9)

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DYNAMIC FLIGHT SIMULATION AS A SUPPLEMENT TO IN-FLIGHT PILOT TRAINING

PROJECT DURATION

OCT 2016 - OCT 2018

OBJECTIVE

Aptima and Soar Technology are conducting a follow-on effort to extend the work achieved under the Carrier Qualification Training Reduction via Advanced Piloting System (CQTRAPS) contract. The purpose of this effort is to advance the capabilities of the single Landing Signal Operator operational trainer, known as the LSOT, resident in the LSO School at NAS Oceana through the incorporation of three products driven by analytical, computational, and data modeling based on real world aviation system and SME data.

VALUE TO THE WARFIGHTER

The analysis will provide input for training requirements based on real world data for future planned upgrades of the LSOT. The computational models will be incorporated into the LSO training to ensure that training material are accurate and target the appropriate learning objectives, providing additional functionality and instructor tools currently lacking in the LSOT.

FUNDING SPONSOR

Naval Air Systems Command (NAVAIR) | Naval Aviation Training Systems Program Office (Program Management Activity [PMA] 205)

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DESCRIPTION

In an effort to mitigate the predicted impact of training optimization on the LSO training pipeline, this effort will provide a rich data set for a working computational model to ensure accurate, real life approaches for training and the development of more accurate flight models based on emerging technologies and pilot proficiency levels. In addition, the data will inform scenarios, events, and metrics for inclusion in the training scenarios for pilots, LSOs, and other Air Ops teams (e.g., Air Boss).

NEED

LSOT deficiencies that are realistic and data driven are requirements being prioritized to Type Commander (TYCOM) and at Enabler Naval Aviation Requirements Group (ENARG) via Force Paddles and the LSO School Office in Charge. In addition, the Precision Landing Mode (PLM) install is being tested for implementation next Fiscal Year and will drive requests for Carrier Qualification (CQ) training and changes to Field Carrier Landing Practice (FCLP) requirements. This effort will help improve training technology for pilots, LSOs, and Primary Flight Control (Pri-Fly) and provide supporting data for recommendations.

BENEFITS

There is currently only a single LSO trainer (LSOT) located at NAS Oceana in the LSO

School. Because of this limited availability, the throughput and maintenance of this device is a difficult problem to manage for LSO instructors and PMA-205 LSOT program managers. Analytical and computational models, as well as a baseline Landing Quality Index to assess CQ and inform LSO training and currency will add to the training value and inform acquisition and currency decisions. By using live data, this scientific effort will help the development of more realistic models and provide additional instructional capabilities that can be implemented in existing and re-hosted LSOT, as well as provide objective data for recommendations.

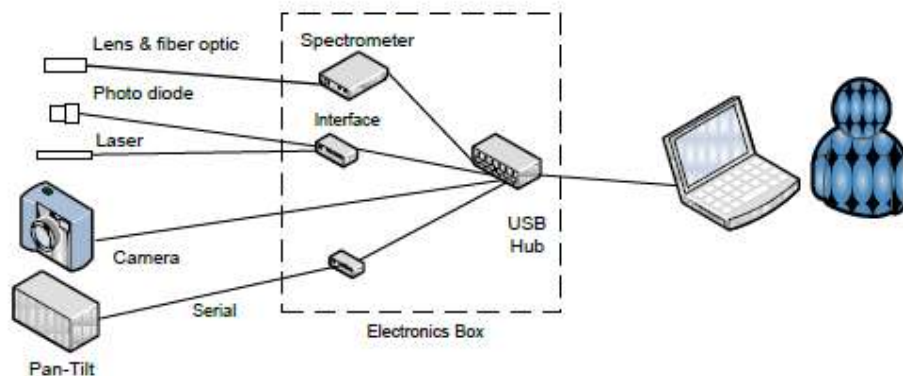
STATUS

Currently at the end of year one, the data have been cleaned and parsed and as a result stand ready for a number of different kinds of analysis. The LSO live data set was used to compute initial landing quality index scores and to begin identifying patterns. The team completed implementation of the threshold level model-simulation API for the Year 1 model.

KEY ACCOMPLISHMENTS

- Created an application that read in all text files in each of the subdirectories and created two comma-separated values (csv) files, one for each subdirectory representing 959,016 traps.
- Developed a grammar that successfully parsed most of the LSO's glideslope comments on the 1500 or so traps in the data set.
- Performed some simple analyses on the resulting data set.
- Developed an initial functional (but incomplete) model of carrier landings. This model flies from the beginning of the groove pattern and "lands" via gradual descent and control maneuvers of the aircraft.
- Implemented the threshold level model-simulation API model and, using the Raft model-simulation interface middleware, developed test capabilities and test scenarios to test API functionality.
- Integrated the model development environment and implemented the initial model, using the goal decomposition developed in consultation with LSO School.

EFFECTIVE MEASURES OF TRAINING DISPLAY SYSTEM PERFORMANCE



The proposal was for Visual Performance to develop a Display Measurement Toolkit which included a number of sensors including camera, spectrometer, laser and photodiode on a pan and tilt mount which allows for benchmarking display system performance.

DESCRIPTION

Despite significant technological advances, the Navy's visual system acceptance tests are still manual, time consuming, and often inconsistent across programs. Significant improvements in the certification process are available through the application of modern metrics and more automated methods of measuring display systems. These improvements would save both time and cost of training display system certification, as well as improve the performance level of such systems.

NEED

Over the past decade, the ability to measure essential display system attributes has advanced to the point where the simulation training industry has multiple suppliers who offer automated display calibration systems, capable of accurate geometry and channel-to-channel co-alignment. However, typical acceptance tests used to certify training display systems are still manual, time consuming, and often inconsistently applied across programs.

BENEFITS

This effort will benefit the Navy by developing innovative metrics, measurement procedures and hardware that are needed to support the certification of simulation training devices.

STATUS

Prototyping of metrics and hardware of a potential Display Measurement Toolkit were developed by Visual Performance. The prototypes include pan and tilt mount and high-resolution digital color camera. Tested metrics included: system resolution, sampling artifacts, contrast, luminance and geometry. Prototype geometry and resolution metrics were compared against traditional testing methods and documented in reports.

PROJECT DURATION

SEP 2016 - MAR 2018

OBJECTIVE

To develop an objective and efficient measurement toolkit for conducting validated acceptance tests for simulation training display systems

VALUE TO THE WARFIGHTER

This effort will benefit the Navy by developing innovative and objective metrics and measurement procedures to support simulation training acceptance.

FUNDING SPONSOR

Naval Air Systems Command
(NAVAIR)

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KEY ACCOMPLISHMENTS

- Phase I Effort completed in 2016.
- Prototype system demonstrations for resolution and geometric metrics.
- Phase II is scheduled to complete Mar 2018 with final prototype demonstration and potential transition to NAWCTSD.

END-USER SPEECH RECOGNITION SUPPORT TOOLS FOR CREW RESOURCE MANAGEMENT TRAINING SYSTEMS

PROJECT DURATION
AUG 2017 - JUL 2020

OBJECTIVE

Develop an innovative software capability to improve the utility of structured automatic speech recognition (ASR) by allowing end-users to customize the set of supported utterances without external support.

VALUE TO THE WARFIGHTER

As platforms pursue integration of speech technologies to augment training gaps not currently addressed under current training and/or instructor role-playing capabilities, one limiting factor is the ability to maintain these systems' relevance. The development of this technology will aid these platforms in the long-term sustainment of speech capabilities without being reliant on outside vendor support.

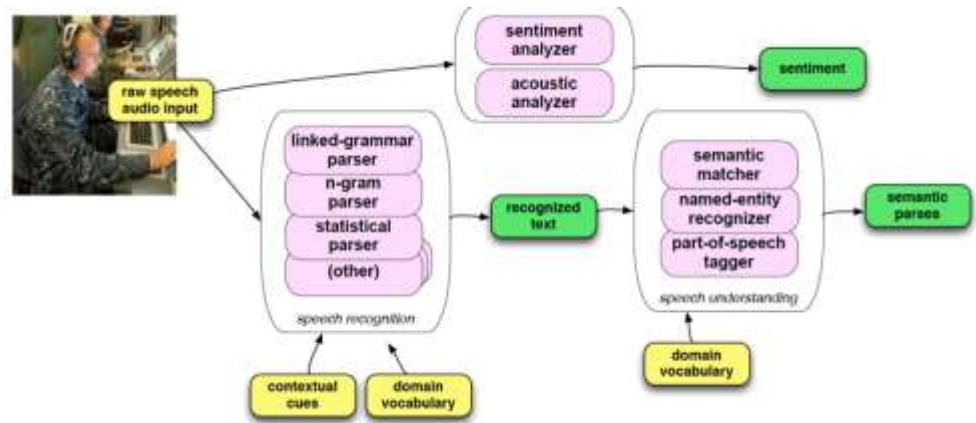
FUNDING SPONSOR

Naval Air Systems Command
(NAVAIR)

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Complex training environments require integrated speech technologies, and due to the reliance on doctrinal language and conversational dialog, underlying speech vocabularies increase in complexity

DESCRIPTION

The resulting software capability should be modular and flexible in nature to allow multiple aviation platforms to leverage the functionality. For example, consider U.S. Naval aviation crews that conduct similar mission sets, but have their own unique doctrinal phraseology. Although each platform may prosecute an anti-submarine warfare (ASW) mission similarly, their doctrinal phraseology is likely specific to their respective platforms. The solution should have enough flexibility to account for platform specific changes, or multiple platform accommodations. Further, the resulting software capability should include up-front "train the speaker" modules.

NEED

ASR successes within simulation-based training systems have been modest. Some domains have overcome the complex challenges that exist in implementing ASR by making use of enforced doctrinal phraseology, which the speech recognition technologies can exploit. However, in more complex and fluid training environments that are less structured, more complex natural-language processing

techniques are necessary to achieve that purpose. These environments require ASR systems with the flexibility for the instructor to customize and edit the feature.

BENEFITS

This effort seeks to provide a capability for end-users of ASR-enabled training systems to edit or customize the feature to better match their particular needs. For example, the technology sought should provide training personnel with functionality to append a particular phrase or a specific term to the existing grammar. Within military domains where tactics and protocols adapt over time, this capability is a significant system upgrade.

STATUS

This STTR has undergone competitive source selection to award Phase I. The selected 3 contractors have spent the Phase I base conducting feasibility analyses and designing/developing prototypes. The awarded industry partners will participate in out brief meetings with the government stakeholders in December 2017 to discuss Phase I progress and Phase II plans.

GOALS FOR FY 2018

- Phase I prototype demonstrations planned for Oct 2017
- Phase II down select

EXPLORATION OF KINESTHETIC AND HAPTIC TECHNOLOGIES IN VIRTUAL TRAINING ENVIRONMENTS



LCDR Ryan Kramer explores a simulated Virginia class submarine in the VR prototype for the Virtual Interactive Shipboard Instructional Tour® (VISIT®).

DESCRIPTION

Our development will focus on integrating various haptic devices with the HTC Vive (VR Head Mounted Display) and Unity (software gaming environment). Each haptic device comes packaged with an Application Programming Interface (API) and a Unity plugin that we must research thoroughly before device testing can begin. Once the various Software Development Kits (SDKs) are fully understood, appropriate tests can be developed to explore the strengths and weaknesses of each device. We will test the ability of each device to perform specific tasks such as turning valves on a submarine and operating controls necessary to power on a Mobile Electric Power Plant (MEPP).

NEED

Haptic devices are an emerging technology and their training benefit has yet to be fully explored and validated. There is a strong demand signal for VR training using these novel, emerging devices. The primary reasons are twofold: (1) the requirement to reduce cost to develop and maintain training, and (2) the desire to provide just-in-time training anywhere, independent of location.

BENEFITS

The knowledge gained during this effort will be leveraged into proposals for customers and serve as the framework to build test beds or prototypes with the plan to transition them into production ready training products such as VISIT3D or Multipurpose Reconfigurable Training System 3D® (MRTS3D®).

STATUS

The FY18 Execution Plan is as follows:

Task 1 (Procurement): Purchase the devices and software.

Task 2 (Learn APIs): Research the programming interfaces and software packages provided with the various devices, become proficient in their use and determine the best method of developing tests for each.

Task 3 (Test Development): Develop and document tests for each device based on the information gathered while exploring the APIs.

PROJECT DURATION

NEW START
OCT 2017 - SEP 2019

OBJECTIVE

The objective of this effort is to enhance a virtual reality (VR) trainer with the ability to teach physical procedures while providing the user with haptic feedback. This will involve a full exploration of the various commercial off-the-shelf wearable haptic devices. We will implement a virtual, full hand simulation and provide both textural and thermal feedback as well as realistic physical resistance in an immersive VR environment.

VALUE TO THE WARFIGHTER

By developing technical experts in the employment of advanced VR technologies, the team will be able to provide authoritative expertise to a wide variety of acquisition efforts including aviation, surface, undersea, and expeditionary audiences.

FUNDING SPONSOR

Naval Air Systems Command
(NAVAIR) | Section 219

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GOALS FOR FY18

In FY18, we plan to explore the latest haptic technologies and their associated software development kits. Upon mastery of the APIs, we will develop performance and capability tests for each platform. It is our goal to procure and explore, at least, five unique devices.

EXTENDED FIELD OF VIEW (FOV) VIDEO AVIATION TRAINING AIDS

PROJECT DURATION

NEW START
OCT 2017 - SEP 2019

OBJECTIVE

Investigate the viability of improving initial flight training by comparing traditional training methods to use of these methods augmented by the incorporation of extended FOV video.

VALUE TO THE WARFIGHTER

Recording representative events from an aviation curriculum in extended FOV video could provide student aviators with perspective on task load, timing, sequence, and spatial orientation of visual and audio cues the student could expect to see during his or her attempt at that syllabus event, as well as demonstrations of appropriate control inputs.

FUNDING SPONSOR

Naval Air Systems Command
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The T-6A Texan II is a tandem-seat, turboprop trainer whose mission is to train Navy and Marine Corps pilots and Naval Flight Officers.

DESCRIPTION

Two populations of student aviator performance will be measured and compared on targeted primary flight syllabus events. During mission planning and rehearsal, the first group will utilize traditional "chair flying" techniques, in which student aviators mentally rehearse for upcoming events by walking through checklists, procedures, and decision points. The second group will have access to extended FOV video recordings of the event that provide perspective on task load, timing, sequence, and spatial orientation of visual and audio cues the student could expect to see during the event.

NEED

360° video and VR training technology are rapidly becoming mainstay, and vendors continue to penetrate senior leadership ranks with promises of effectiveness. Empirical evidence of the effectiveness of these training media for the undergraduate military flight curriculum is urgently needed by PMA and

resource sponsor decision makers to help these and other NAE stakeholders make better informed decisions about capability purchases. We need a much stronger body of literature regarding the utility of VR for aviation training.

BENEFITS

Incorporating extended FOV video into training could yield faster orientation to challenging mission types, as students would already have exposure to the visual and audio cue and decision sequences they could expect to see. The simulator and flight time typically required to develop situational awareness to a new flight regime could be potentially reduced.

STATUS

This is an FY18 new start. Anticipated deliverables include one or more representative training syllabus events captured in extended FOV video supplemented with training cues and content for both T-6 and TH-57 platforms for playback in either VR Headsets or tablet devices with headsets for playback.

GOALS FOR FY18

- IRB Approval
- Identification and capturing of multiple instances of a representative sortie in each platform.
- Conduct recording and playback media analyses.
- Design metrics and experimental design.

FLIGHT DECK CREW REFRESHER TRAINING EXPANSION PACKS (TEP)



Left: Screenshot of actual 3D flight deck and aircraft models used for the effort.

Below: Concept diagram for immersive technologies



DESCRIPTION

The NAWCTSD team intends to focus development on the overall system baseline architecture, the Primary Flight Control (Pri-Fly) TEP, and its connectivity to the Landing Signal Officer (TEP) by following a proven development approach which incorporates streamlined System Engineering Technical Reviews (SETR) and interim Fleet progress reviews. NAWCTSD will utilize its expertise in the science of learning, individual and team training, and human performance to ensure the technology and content addresses the training needs of the audience through a task analysis, metric development, and include a Training Effectiveness Evaluation (TEE).

NEED

Flight Deck Crew readiness, refresher, and certification training opportunities are limited. The training pipeline and available technology for flight deck crew initial training is often limited or outdated. Flight deck crew members are often sent to other underway carriers for refresher training and readiness sustainment. This is costly to the ship and logistically challenging. This practice results in crew members not training with their actual team members. New Ford Class carrier crew members are not training on the correct ALRE gear.

BENEFITS

- Increase readiness, refresher, and certification training opportunities for aircraft carrier flight deck personnel by providing training at FCAs for individual, teams, and multi-team coordination.
- Allow for single trainee, single team, and multi-team training opportunities for flight deck crews.

- Prevent stovepipe training solutions for flight deck crews.
- Target crew specific ALRE and flight deck parameters (e.g., Legacy Steam Catapults vs EMALS).
- Include technologies that allow trainees to use realistic communications and equipment and provide an immersive environment for the trainee with the appropriate fidelity.

STATUS

This is a new effort that is underway. Current development is focused on (1) core software baseline architecture that shall be used to interconnect all individual TEPs, (2) the Primary Flight Control (Pri-Fly) Training Expansion Pack (TEP), and (3) a Training Effectiveness Evaluation (TEE) for the Pri-Fly TEP. This approach shall build and demonstrate the entire Pri-Fly Refresher Course, and demonstrate connectivity to a station of the LSO TEP (leveraged from a separate development effort).

PROJECT DURATION JUL 2017 - AUG 2018

OBJECTIVE

The objective of this effort is to create an expandable framework of game-engine-based, immersive 3D Flight Deck Crew Refresher Training Expansion Packs (TEPs) for use by trainees in Fleet Concentration Areas (FCAs). The TEPs shall allow for individual, team, or multi-team training events, and shall utilize appropriate combinations of state of the industry immersive technologies, including virtual reality.

VALUE TO THE WARFIGHTER

This effort will provide cost effective readiness, refresher, and certification training for aircraft carrier flight deck personnel, which targets crew specific Aircraft Launch and Recovery Equipment (ALRE) and flight deck parameters (e.g., Legacy Steam Catapults vs Electromagnetic Aircraft Launch System [EMALS]).

FUNDING & SPONSOR Office of Naval Research (ONR)

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GOALS FOR FY18

Final system:

- Pri-Fly TEP with connectivity to a second TEP (LSO and/or Catapult Crew)
- Software Baseline Architecture for connectivity of all future TEPs

Documentation:

- User Manual
- Technical Manual

Final report, to include:

- Ending technology readiness level (TRL): TRL Level 6
 - The Training Effectiveness Evaluation (TEE) results and analysis shall also be presented at the demonstration and a final report will be made available to the Fleet at the end of the effort.

IMMERSIVE PARACHUTE DESCENT PROCEDURE, MALFUNCTION, AND DECISION-MAKING TRAINING SYSTEM

PROJECT DURATION

JUN 2016 - SEP 2021

OBJECTIVE

Develop a novel reconfigurable device training system that provides immersive Parachute Descent Procedure (PDP), malfunction and decision-making training to allow the survival training community to deliver cross-platform training without the need for multiple training systems or platform specific peripherals.

VALUE TO THE WARFIGHTER

This project will provide the warfighter with the capability for cross-platform survival training without the need for multiple training systems, at a higher fidelity and a lower cost, allowing for easier training at a faster rate.

FUNDING SPONSOR

Naval Air Systems Command (NAVAIR)

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Naval Aircrewman Operator 1st Class Michael Griffin, an instructor with Aviation Survival Training Center Jacksonville, right, runs the virtual reality parachute descent trainer, while making sure Naval Aircrewman Operator 1st Class Albert Flores with Patrol Squadron 10 correctly runs through his descent procedures. The trainer is designed to give students a realistic feel for parachute steering, allowing them to experience and correct potential problems when a parachute deploys.

DESCRIPTION

This project is a Small Business Innovative Research (SBIR) project targeted at researching, designing, and developing a novel, immersive training system that provides the ability to train aviators by addressing three capabilities gaps: 1) training quality and effectiveness, 2) supportability, and 3) training realism. The training system should provide a reconfigurable interface that supports all Navy standard flight equipment and parachute equipment. Developed technology would provide the ability to demonstrate effectively both standard procedures (e.g., inflation of the life preserver, releasing the raft when applicable) and parachute malfunctions.

NEED

Current parachute procedure safety training is based on technology that has inadequate effectiveness and realism, primarily due to limitations that prevent interfacing with standard flight and parachute equipment. An advanced training solution will provide a

reconfigurable connection for a variety of aircrew equipment and seat kits, which differ by platform.

BENEFITS

Cross-platform survival training, without the need for multiple training systems, will help avoid potential training costs, as well as allow aviators more flexibility within training systems. The increased fidelity of the training will also help aviators more effectively learn about parachute descent procedures, which are important survival procedures.

STATUS

This SBIR has undergone competitive source selection to award Phase I, during which 3 contractors conducted feasibility analyses and designed/developed prototypes. Following evaluations of Phase I efforts, a down select award was made to two contractors. Phase II contract awards are expected in FY18 Q1, and will continue research and development focusing on the reconfigurable requirements of the device to address all aviation platforms.

KEY ACCOMPLISHMENTS

- FY 2017
 - Workforce Development: Mentoring of junior research psychologists on project management and collaboration with program sponsors, fleet customers, and contractors.
- Prior FYs
 - Presentations: Lando, S., Scheeler, W. T., Atkinson, B. F. W., & Mercado, A. (2015, November). *Challenges facing the parachute descent procedure training and desired technological advances for training systems*. Presented at the SAFE Symposium, Orlando, FL.
 - Workforce Development: Mentoring of junior research psychologists on project management and collaboration with program sponsors, fleet customers, and contractors.

INNOVATIVE COLLIMATED DISPLAYS



The curved display mirror, in the center, generates virtual (collimated image) of the projected image on the right. The projected image position is controlled by actuators that allow for translation and tilt. This translation changes the location of the virtual image which causes the viewer to accommodate at different distances. The image on the left (reference) is a traditional 2D image with fix accommodation and vergence cues at the display surface.

DESCRIPTION

As part of the Phase II, Holochip completed two unique optical system designs for a variable collimation display (VCD). The basic principle of the VCD is based on controlling the curvature of the wavefront of light reaching the eyes of the user. When the curvature is flat, the light is 'collimated' and the image appears at a nearly infinite distance from the user; likewise, as the curvature of the wavefront increases, the image appears to move closer to the user. Both approaches employ a conventional wide-area collimated (WAC) mirror and beamsplitter to direct the light to the user's eyes.

NEED

Rotary wing platforms require a complex set of flight regimes and close proximity visual cues during hovering, take-off and landing, search and rescue, confined area and emergency landing, and cargo loading/unloading operations. Current aircraft simulator visual displays provide monoscopic visual cues using either real image or fixed collimated displays. No optimal solution exists today for low altitude operations that provide binocular disparity, and correct vergence-and-accommodation at low altitudes.

BENEFITS

A variable collimation display will provide accurate accommodation and vergence based on the aircraft distance to the ground. It is expected that this innovative display technology would improve the visual cues provided to pilots and therefore improve safety and training. Furthermore this display technology may also contribute to enhancements on numerous other displays

applications currently limited by a lack of accurate depth cues.

STATUS

The control system, including drive electronics and software, were completed and demonstrated. The system was tested using a vergence meter to quantify collimation. A rudimentary flight simulation based on the Unreal game engine will provide visuals for the display. The software extracts values of interest from the simulation such as Height Above Terrain (HAT) and distance of a particular object from the viewer. This data is communicated via serial port to a microcontroller which controls the hardware (i.e. projection location) attached to the system.

PROJECT DURATION

OCT 2013 - JAN 2017

OBJECTIVE

Develop innovative visual displays to provide variable collimation and improved 3D depth perception for rotary wing chin windows and cargo hatch operation.

VALUE TO THE WARFIGHTER

A variable collimation display will provide accurate accommodation and vergence based on the aircraft distance to the ground.

FUNDING SPONSOR

Naval Air Systems Command
(NAVAIR)

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KEY ACCOMPLISHMENTS

- Publication: Batchko, R., Robinson, S., Schmidt, J., & Graniela, B. (2014, March). A variable-collimation display system. In Proc. SPIE (Vol. 9011, p. 901109).
- SBIR contractor, Holochip investigated a miniature version of the adaptive fluidic lens applied to a head mounted display (HMD) in order to provide variable collimation (i.e., variable accommodation) in virtual reality (VR) environments.
- A Phase II.5 is planned for the implementation of variable accommodation in an augmented reality HMD for virtual reality deployable trainers

SMALL PROJECTOR ARRAY DISPLAY SYSTEM

PROJECT DURATION

FEB 2017 - JAN 2018

OBJECTIVE

To produce an optical blinder system for Out-The-Window display systems that utilize stacked projectors in the vertical and horizontal direction that can be remotely tuned for night and NVG scenes. Visual display systems in this configuration have very limited access for tuning the optical blinder system.

VALUE TO THE WARFIGHTER

For night and NVG scenes, optical blinders (blend plates) are required with digital projectors to eliminate black level overlap not correctable by electronic blending. The new system will provide a superior method for setup and maintaining a high quality edge blend for the training system and reduce trainer down time by simplifying tuning to meet optimal scene quality after projector replacement.

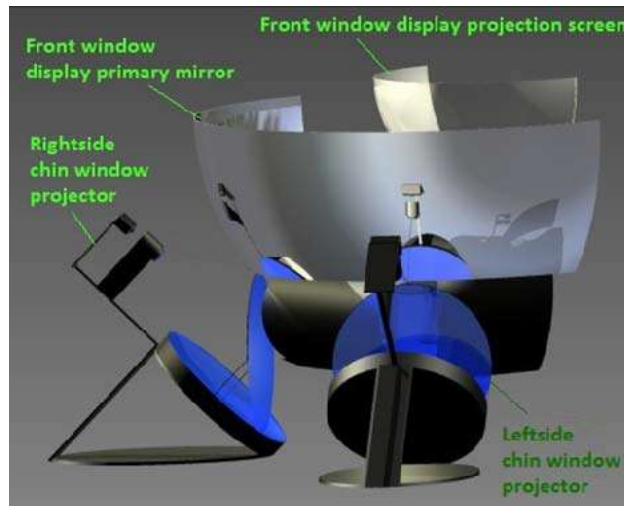
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3D model of display integrated in flight simulator with external housing omitted. Diagram courtesy of Holochip Corporation.

DESCRIPTION

Under this project, new concepts, algorithms, and devices will be researched to produce an optical blinder design which limits required personnel access to these devices during night and NVG edge blend display tuning. Methods such as remote edge shape control, precision measurement using auto-alignment capabilities, automated edge material construction (3D printing on CNC-like material cutting) will be explored to develop a process that creates accurate blinder edge shapes with minimized projector platform access.

NEED

Current blinder methods use fixed edge shapes with a single direction of motion, often requiring 'hand-tuning' of each edge shape in the projection system by accessing the projection frustum, inserting blinding material, estimating the shape, cutting the estimated shape, attaching that cut edge to the blinder assembly, and then adjusting the position using remote

software. This can be tedious, iterative, and require several iterations of access to the projector assembly with the attached blinders.

BENEFITS

The benefits of this approach are faster setup and higher scene quality blending of projectors for night and NVG scenes used for training task such as pilot training, aerial gunnery, external lift operations, combat scenarios, standard and emergency flight procedures, hoist operations and crew coordination in simulated day or night all-weather conditions. This approach will reduce down time when projectors have to be replaced and allow for tuning the blending of projectors remotely.

STATUS

The Enhancement is a new FY17 effort that will build on the original SBIR Phase II design of a 2 axis projector blinder plate design.

KEY ACCOMPLISHMENTS

- The contractor has designed and tested several blinder plate prototypes of different materials and ways to manufacture on site.
- The initial mechanical design has been completed and ready for building.
 - The electronics design and module selection has been completed.
- The software selection for embedded operating system for the controller has been determined; the software design has been completed and is now in development.
- For the original Phase II the contractor demonstrated prototype and delivered Phase II Final Report. (Sep 15).

SPATIAL AUGMENTED REALITY TRAINING UTILIZING A TRANSPARENT DISPLAY



Transparent User Experiences (TUX) Demonstration software augmented a workspace with a representation of equipment alongside instructional document and video

DESCRIPTION

R&D was performed on modern software development practices for AR targeting the Microsoft HoloLens. Based on Instructional Systems Design (ISD) inputs, general use cases for content delivery schemes were identified. The team completed the TUX Demonstration software for the HoloLens. These prototypes were based on internal training software to speed prototyping process. ISD evaluations were performed on prototypes as they were developed. The team networked with augmented reality (AR) content developers across the fleet, including attending the Naval Future Force Science and Technology Expo 2017 and joining Naval Augmented Reality Consortium (NARC) group. A Government Report was submitted.

NEED

This project addresses a need for scenario-based training that mimics operating equipment in the context of performing the work, without utilizing the actual equipment being trained to. The HoloLens has made high-fidelity low-cost AR mature enough to be worth evaluating as a solution in alignment with STOs for Training and Education and Total Ownership Cost. This presents an opportunity augment on-the-job training both ashore and afloat. Getting a head-start on the research means speed-to-fleet for successful findings.

BENEFITS

As AR becomes more commonly used across the U.S. Navy, expertise in developing valuable content for AR devices is a crucial capability. CDIL engineers need this training to remain at the forefront of this emerging technology. R&D of AR technology enhances the ability of the Concept Development and Integration Laboratory (CDIL) to develop and integrate AR software into current training systems, on-the-job-training scenarios, and LVC exercises across the fleet. These AR technologies will allow warfighters a flexible means of on-site preparedness. Targeting AR software content at low cost HMDs provides a cost savings and an ease of serving many trainees compared to producing limited training articles.

STATUS

The project completed in FY17. Prototypes developed will be maintained in CDIL software repositories. Demonstrations of the TUX software are planned in the future as a means to reach out to fleet. Topics identified but not fully explored during this effort will be proposed for exploration in future efforts. These include training procedure completeness/correctness tracking integrated with performance support & equipment simulation, more complicated AR objects interacting with each other, direct interoperability with physical equipment to coordinate AR effects with system state, and research on form, fit, and comfort issues with HoloLens.

PROJECT DURATION
OCT 2016 - SEP 2017

OBJECTIVE

Investigate and develop skills for producing Augmented Reality (AR) software targeting onsite training delivery and performance support for operational environments. Develop Proof-of-Concept (PoC) AR software culminating in a Transparent User Experiences (TUX) Demonstration software application targeting the Microsoft HoloLens AR head mounted display (HMD). Perform Instructional System Design (ISD) evaluations on prototypes and HoloLens hardware to observe usability and training effectiveness.

VALUE TO THE WARFIGHTER

The Concept Development and Integration Laboratory (CDIL) gained experience with developing and integrating state-of-the-art AR which can be targeted at current and future training systems for Warfighters. Knowledge of the capabilities and limitations of AR allows for better decision making when planning requirements for training, performance support, and LVC events in support of the Warfighter.

FUNDING SPONSOR

Naval Air Systems Command
(NAVAIR) | Section 219

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KEY ACCOMPLISHMENTS

- The team acquired access to Microsoft HoloLens hardware and development computers.
- The first prototype of existing radio panel trainer was developed and deployed on the Microsoft HoloLens.
- The Primary Investigator (PI) attended a conference to learn about AR development across Navy (Naval Future Force Science and Technology Expo 2017).
- The PI joined NARC group for cross-agency discussion of AR development.
- The team completed TUX Demonstration AR software application for Microsoft HoloLens.
- The team delivered a Government Report of findings.

TRANSITION OF A PRESSURE ON-DEMAND NORMOBARIC HYPOXIA TRAINING DEVICE FOR SURVIVAL SCHOOLHOUSES

PROJECT DURATION

★NEW START★

OCT 2017 - SEP 2019

OBJECTIVE

The effort seeks to support the technology transition of a next generation hypoxia-training device under development as part of NAVAIR SBIR N132-093. The goals of this research include analysis of logistical concerns, human factors evaluations, and human testing to validate the fidelity and effectiveness.

VALUE TO THE WARFIGHTER

This project will support transition of a new mask-on hypoxia training device which will increase training fidelity through pressure-on-demand capability. Prior to widely employing these novel training devices, data will be needed to ensure that the systems are reliable and effective in delivering hypoxia training. This effort will provide the data needed to make a procurement decision.

FUNDING SPONSOR

Naval Air Systems Command
(NAVAIR) | Section 219

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Engineering testing of On-Demand Hypoxia Trainer with Aerospace Physiologists at NAS Pensacola to validate pressure on demand and initial training profile for hypoxia training.

DESCRIPTION

This effort will conduct the research and development efforts necessary for validating the fidelity, safety and concept of operations of the On-Demand Hypoxia Training Device under development for transition to PMA-205. In addition to the required research, we intend to conduct separate independent tests and evaluations to document the performance parameters and benefits of the novel technology for existing and potential acquisition communities. Specific tasks include: research and analysis of logistic requirements for training technology; conduct Human Factors Evaluation of the instructor console; conduct human testing with a military aviator population; and validation of training system.

NEED

As hypoxia continues to remain a highly visible safety issue, focus on a range of potential mitigation solutions is imperative. While a variety of engineering solutions aimed at the aircraft are being considered and tested, the final line of defense will remain in the hands of our trainers.

BENEFITS

The acknowledged success of hypoxia training makes it paramount that the Navy ensures these capabilities remain available. In addition to providing a means for addressing the larger Navy research into mitigating hypoxia physiological episodes, this effort will advance the lab's understanding of hypoxia training. Through usability analyses, researchers will document ways to increase the ease of use of the instructional capability. Further, this effort will provide the means to thoroughly investigate a novel technology to determine the effectiveness and efficiency of the devices to deliver higher fidelity training opportunities.

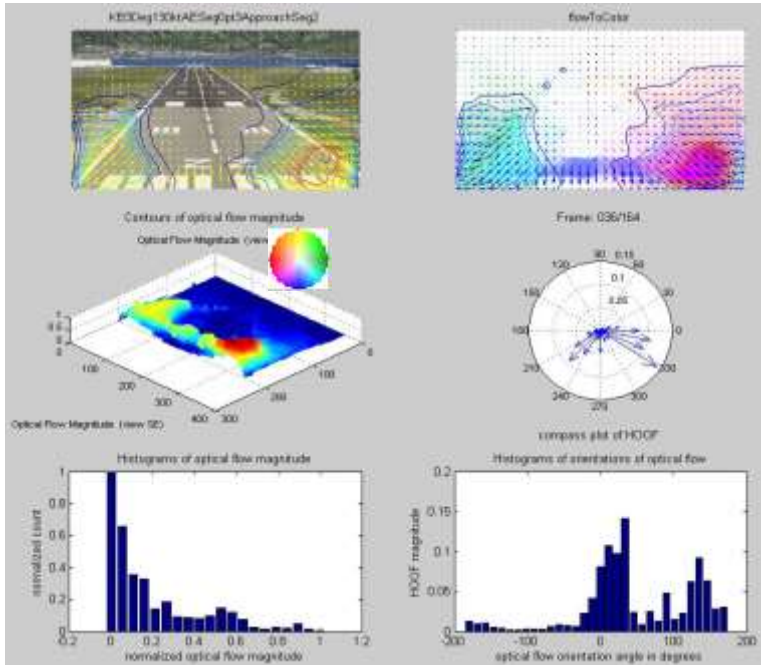
STATUS

This effort was selected for award as a FY18 new start. First year tasking in FY18 will focus on researching logistic requirements, conducting human factors evaluations of the prototype instructor console, and preliminary human testing with a military population.

KEY ACCOMPLISHMENTS

- Research and analysis of logistic requirements for training technology.
- Conduct Human Factors Evaluation of the instructor console.
- Engineering a novel technology to increase fidelity and safety for navy aviation hypoxia training. (2017, November). Presented at the SAFE Symposium, Orlando, FL
- Demonstration at the United States Naval Aeromedical Conference 2017 and I/ITSEC 2017.

VIRTUAL ENVIRONMENT MOTION FIDELITY MODEL



Landing image sequence with overlaid optical flow field, contours and color mapping.
The Histogram of Oriented Optical Flow (center right) provides a descriptor for the optical flow generated during a landing task.

DESCRIPTION

The aircraft simulator synthetic environment needs to provide enough visual stimulation to the human visual system so the pilot can make sense of motion from the optical flow. At this point, no quantitative metrics exist for the assessment of visual motion cues in aircraft simulator environments. Furthermore, aircraft simulator visual and sensor database development and testing do not use any quantitative visual performance metrics for the placement and density of features on the terrain. This research investigates the possible metrics and threshold of motion fidelity through a virtual environment so that cost and technology contains can be balance.

NEED

Significant differences in optical flow between real world scenes and virtual environment may result in motion cues that generate the incorrect visual perception of speed, height and heading. This situation may develop pilot mental models in simulated environments that do not transfer well to real world situations. A computational model with corresponding metrics that can quantify the fidelity-relevant differences between virtual environment and the real world can be used to predict and measure the level of fidelity of simulator virtual environment.

BENEFITS

This virtual environment motion fidelity model can enable enhanced visual cues for low level flight and increased simulator virtual environment fidelity. First, the model can be used to predict the virtual environment characteristics necessary to meet or exceed fidelity requirements. Secondly, it can be used as a validation tool for assessing achievement of visual database and visual system requirement.

STATUS

FY17 was the last year for this project. The process for capturing, and comparing virtual environments, which includes video alignment and filtering techniques, as well as statistical comparisons using non-parametric multivariate analysis of variance (MANOVA) was documented in a final report.

PROJECT DURATION
OCT 2015 - SEP 2017

OBJECTIVE

The goal of this project is to develop a virtual environment motion fidelity model that can quantify low level flight motion visual cues and predict the correct combination of visual and sensor terrain database features for low altitude operations in flight simulators. The approach involves image motion metrics captured for reference and test scenes, and compared to generate a quality metric.

VALUE TO THE WARFIGHTER

A computational model with corresponding metrics that can quantify the fidelity-relevant differences between virtual environment and the real world, as captured using video footage, can be used to predict and measure the level of fidelity yielded by visual stimulation of the human vision system and ultimately the perception of the environment cues.

FUNDING SPONSOR

Naval Air Systems Command
(NAVAIR) | Section 219

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KEY ACCOMPLISHMENTS

- Applied the skills learned in Matlab to the development of an application for Ed Forsman from the Photogrammetrics Team (5.2.4.4) at Optical Systems Branch Atlantic Test Range.

CYBERSPACE OPERATIONS DEGRADED EXERCISE & SYNTHETIC TRAINING ARCHITECTURE (CODESTAR)

PROJECT DURATION

JUN 2017 - MAY 2018

OBJECTIVE

Design, develop and demonstrate an architecture and cyber threat simulation software that can safely, securely, and realistically degrade critical surface warfare capabilities in support of Fleet mission assurance and Continuity of Operations (COOP) training requirements.

VALUE TO THE WARFIGHTER

Provides opportunities for the training audience to realistically experience and respond to cyber threats and intrusions. Addresses missed opportunity to practice Concepts of Operations (CONOPS) and Tactics, Techniques, and Procedures (TTPs).

FUNDING SPONSOR

Office of Naval Research (ONR)

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DESCRIPTION

- Develop a concept, preliminary architecture, and cyber threat simulation software to safely, securely, and realistically incorporate degraded and denied conditions into Fleet synthetic training events.
- Detail which Navy training architectures, standards, models and simulations, and interfaces need to be updated to include Degraded Synthetic Training (DST) effects representations.
- Develop a detailed DST prototype that is compatible with training architectures and standards.

NEED

Cyber training ranges operate independently from the traditional M&S environments used to conduct battle staff and Fleet Synthetic Training (FST). Capabilities are needed at the tactical level to provide fleet surface warfare operators and leaders the opportunity to develop and practice Concepts of Operations (CONOPS)

and Tactics, Techniques, and Procedures (TTP) for "fighting through" degraded and denied conditions.

BENEFITS

CODESTAR will extend an existing Degraded Synthetic Training Architecture with intelligent scenario adaptation tools. These tools will reduce the workload of instructors, training officers and exercise controllers through an interface console, while ensuring delivery of a high-quality experience to learners.

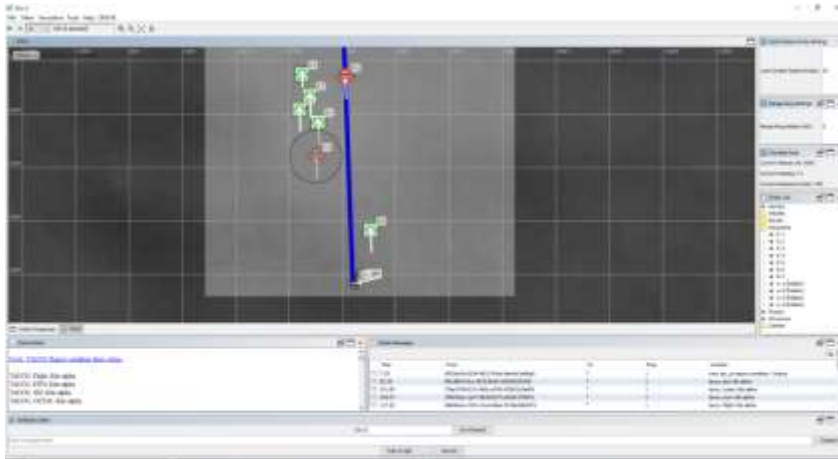
STATUS

This effort is an FY18 new start.

GOALS FOR FY18

- Define training requirements and extensions to the architecture
- Develop agent-based cyberspace training executive agent
- Design and implement a cyberspace management console

CREW ROLE-PLAYER ENABLED BY AUTOMATED TECHNOLOGY ENHANCEMENTS (CREATE)



Prototype user interface for scenario management and tracking speech capability recognition and generation results

DESCRIPTION

This effort seeks to design and develop a software application/suite that provides a synthetic role-playing capability will serve to enhance the training pipeline and potentially avoid costs and provide value added without the use of training aids. The required technology solution must integrate speech capabilities (i.e., recognition, understanding, synthesis), SME level tactical domain information, reaction to multitasking and high stress situations, and relay of information via means other than speech communication (e.g., software inputs), are required.

NEED

Current Navy crew training requires the assembly of an entire crew or the use of Subject Matter Experts to support crew training. While training benefits from the additional costs associated with bringing a full crew together, some individual training could benefit from the added realism provided by crew interaction. During these events, the emphasis is on the crew member's individual skills; however, many tasks associated with their role may rely on inputs from other crewmembers.

BENEFITS

CREATE will enhance the training pipeline, by streamlining the instructor's efforts during training. This will also add to the potential cost avoidance and provide value added without the use of training aids. Instructors will be able to manage more trainees at once in a more efficient manner, and be able to deliver more tailored instruction and feedback if necessary, increasing the quality of the training.

STATUS

This SBIR has undergone competitive source selection to award Phase I, during which 3 contractors conducted feasibility analyses and designed/developed prototypes. Following evaluations of Phase I efforts, a down select award was made to Soar Technologies. During Phase II efforts, continued component research and development occurred with periodic demonstrations to the P-8A Fleet Project Team. A Phase II.5 effort was awarded in FY17, which continued development and allowed for initial testing of the speech recognition and generation system.

PROJECT DURATION
OCT 2014 - SEP 2020

OBJECTIVE

Develop a software application/suite that provides a synthetic crew role player to support complex crewmember interactions during dynamic training events.

VALUE TO THE WARFIGHTER

CREATE will enhance the training pipeline such that trainees will have a new autonomous crew member to interact with in order to assist in training communication and coordination protocols. This allows for trainees to engage in task-based training and teamwork-based training simultaneously.

FUNDING SPONSOR

Naval Air Systems Command
(NAVAIR)

POINTS OF CONTACT

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KEY ACCOMPLISHMENTS

- **Manuscripts/Publications:** Atkinson, B. F. W., Killilea, J. P., Stensrud, B., Marinier, B., Schermerhorn, P., Dettmering, C., Saadat, S., & Anania, E. C. (2017). Crew role-players enabled by automated technology enhancements. Proceedings of the Interservice/Industry Training Simulation & Education Conference, Orlando, FL.
- **Presentations:** Anania, E. C., Atkinson, B. F. W., & Killilea, J. (2017, October). The application of automation systems for training - Implications of trust. Presented at the SAFE Symposium, Orlando, FL.
- Demonstrated as part of the U.S. Navy exhibit at I/ITSEC 2017.
- **Workforce Development:** Mentoring of junior research psychologists on project management and collaboration with program sponsors, fleet customers, and contractors.
- **Transitions:** Targeting transition to the P-8A training software (TSR-16, FY19/20)

DISTRIBUTED SYNTHETIC ENVIRONMENT CORRELATION ARCHITECTURE AND METRICS

PROJECT DURATION

AUG 2015 - JAN 2018

OBJECTIVE

Develop an innovative and extensible distributed synthetic environment correlation assessment architecture that can verify correlation between flight simulator visual and sensor databases.

VALUE TO THE WARFIGHTER

As the US Navy and US Marine Corps move toward integrating existing flight simulators into common training environments, the importance of having a correlated, correct environmental representation is vital for achieving a fair fight and a high training value to the warfighter.

FUNDING SPONSOR

Naval Air Systems Command
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The GameSim Validate tool is able to compare source data such as the NAVAIR Portable Source Initiative, semi-automated forces, and image generator runtime representations. Correlation between these representations takes into consideration not only the geometry and attributes but also scenario, areas of interest, and training objectives.

DESCRIPTION

The aim of this study was to research and prototype a terrain database validation and correlation assessment system that works from both direct and indirect data sources, including NPSI dataset to NPSI dataset, NPSI dataset to runtime, and runtime to runtime comparisons. This SBIR will generate a flexible and expandable distributed synthetic environment correlation assessment architecture for aviation platforms that will be able to perform comparisons (correlation) between different formats, versions of the same visual databases, and the original geospatial source data.

NEED

Correlation assessments between terrain databases and interoperability of simulation models have been investigated over the years. However, a gap still exists in the automated assessments of correlation between large synthetic environments as far as it relates to visual and sensor simulation for U.S. Navy / Marine Corps flight simulators.

BENEFITS

The architecture will allow for the addition of new runtime and source formats, as well as new tests and analysis plug-in modules by third party developers. The correlation assessment is expected to put emphasis on aircraft mission areas of interest such as airports, landing zones, confined area landings, low-level terrain flight areas, and ranges. Furthermore, the correlation assessment will allow for the automated correlation assessment of designated areas of interest that affect mission performance, such as avenues of approach, key landmarks, feature densities and texture densities.

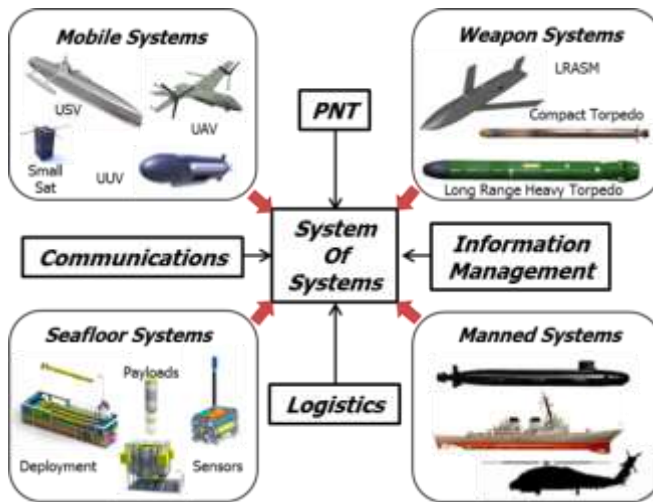
STATUS

GameSim has developed a framework, called Validate, to detect synthetic environment correlation and integrity errors realized in military training systems. Validate provides a means to test correlation between any combination of source datasets, such as the NAVAIR Portable Source Initiative (NPSI) and run-time image generation systems (IG). Implemented tests to date include; terrain elevation, elevation gap, slope, feature presence, feature placement, imagery resolution, and material comparison.

KEY ACCOMPLISHMENTS

- GameSim has tested these correlation tests between NPSI data sets provided by NAWCTSD (Source-to-Source) and between Rockwell Collins, Diamond Visionics and Aechelon image generators (Source-to-Runtime, and Runtime-to-Runtime).
- Publications
 - Joseph, J., Graniela, B. (2015). Terrain database fit-for-use correlation indicators. IMAGE Conference
 - Joseph, J., Graniela, B. (2015). Automated Runtime Terrain Database Correlation Assessment. The Interservice/Industry Training, Simulation & Education Conference (I/ITSEC), Orlando FL.

CROSS DOMAIN MARITIME SURVEILLANCE AND TARGETING (CDMaST)



DESCRIPTION

NAWCTSD was given the challenge to create a synthetic environment for DARPA's CDMaST project. A team of interdisciplinary experts was to use a combination gateways, semi-automated forces, plugins and protocols to create a networked solution that represents three main elements CDMaST was attempting to achieve for experimentation - live, virtual and constructive (LVC). Simulated behaviors had to be prepared in the best way possible to be considered as a fair fight. The demonstration had to include ships, submarines, aircraft, unmanned vehicles, jamming, acoustics and RF signals. NAWCTSD's expertise was the enabling factor in providing this demonstration.

NEED

This effort supports DARPA's mission for transformational change to develop system capabilities. Technology enablers were to be evaluated at Technology Readiness Level (TRL) 4.

BENEFITS

The technologies developed under CDMaST are expected to deliver much greater military effectiveness at lower cost, impose greater cost on the adversary to counter than for us to field, and to produce a cross domain architecture that integrates the kill chain.

STATUS

NAWCTSD's tasks were completed - delivered a demonstration of a representative synthetic environment for consideration at the beginning of the second quarter of FY17.

PROJECT DURATION

JAN 2016 - FEB 2017

OBJECTIVE

The objective of the program is to define innovative architectures, conduct experiments, and demonstrate effective military capabilities. CDMaST is developing a "System of Systems" approach to surveil and target adversaries in highly contested maritime environments over wide geographical areas. NAWCTSD's objective is to provide an enveloping synthetic environment for demonstration of modeled signals and behaviors - a method to evaluate prototypical systems.

VALUE TO THE WARFIGHTER

CDMaST is an approach to distribute functionality across networks of manned and unmanned platforms, sensors, weapons and mission systems. If successful, Warfighters can fight as a network to increase adaptability.

FUNDING SPONSOR

Defense Advanced Research Projects Agency (DARPA)

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KEY ACCOMPLISHMENTS

- NAWCTSD accomplished its goals for the expected live, virtual and constructive (LVC) demonstration.
 - The synthetic environment consisted of a unique blend of entities from multiple semi-automated force products, a virtual component complete with actual military operators, and the integration of a clever live radio component to make it a comprehensive LVC scenario.
 - Not only did this demonstrate to the DARPA sponsor an integrated M&S approach needed for the CDMaST program, we also demonstrated these accomplishments to the Deputy Chief of Naval Operations for Warfare Systems (OPNAV N9).
 - The team's knowledge and experience were the perfect combination we needed to accomplish our goals.
- NAWCTSD surveyed key players within the modeling and simulation community to establish requirements and completed the initial planning for demonstration of a synthetic environment conducive to the DARPA program manager's expectations.

DISTRIBUTED TRAINING NETWORK GUARD (DTNG)

PROJECT DURATION

OCT 2016 - SEPT 2019

OBJECTIVE

Develop a controlled interface that allows for extension and enhancements in a cost effective, short time period. The DTNG controlled interface operates between two simulation network security enclaves of differing administrative domains having the same security classification. The DTNG enforces security policies and controls the flow of information between these domains via a filtering rule set that pass, fail, or sanitize the training simulation data.

VALUE TO THE WARFIGHTER

The DTNG provides the capability to conduct coalition unit, joint, and theatre level training exercises while protecting platform sensitive data.

FUNDING SPONSOR

Naval Aviation Training Systems
Program Office (Program
Management Activity [PMA] 205) |
Joint Strike Fighter (JSF)

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DTNG Logo

DESCRIPTION

The DTNG provides a capability to label, segregate, protect, and exchange data between two interconnected simulation networks operating at the same classification level. This capability is designed to meet the data format and near real-time performance requirements of distributed training exercises.

As a controlled interface, the fundamental security requirements for the DTNG are to (a) protect classified information appropriately, (b) protect information from malicious or accidental tampering, loss, and destruction, (c) protect the DTNG system from foreseeable denial of service conditions, and (d) manage changes affecting the security of the DTNG.

NEED

Distributed training environments are in need of a controlled interface that enables training system connectivity with the ability to process multiple live, virtual and constructive (LVC) protocols, offering protection of program-specific "need-to-know" data from one or more of the participating training systems.

BENEFITS

The DTNG allows the various aviation platforms such as F/A-18, JSF, and E-2D to

train in LVC environments with coalition partners while protecting sensitive information. Aviation platforms will no longer be limited to Training and Readiness (T&R) checks at the lowest required level of classification, and will greatly increase the efficiency and usage of training systems. Aviation platforms will also no longer need to hold separate, standalone events to conduct their higher classification specific, protected data training—allowing more Navy crews to train together and increase the number of T&R opportunities.

STATUS

DTNG was developed in the Interoperability, Design, Engineering & Application (IDEA) lab. The first DTNG system was deployed in the Navy Aviation Distributed Training Center (NADTC) at NAS Oceana in May 2017. Additional DTNG systems are planned for deployment to the NADTC in the second quarter of FY-19 to support other Navy aviation platforms. The DTNG supports the Distributed Interactive Simulation (DIS) v6 simulation protocol, while maintaining interoperability with High Level Architecture (HLA) simulation protocols with the use of the Joint Simulation Bus (JBUS) gateway. Native HLA 1.3 and HLA 1516e interfaces are in development.

KEY ACCOMPLISHMENTS

- DTNG v3.1.3 baseline received Interim Authority to Test (IATT) to support F-18 C/D training in May 2017 with Authorization to Operate (ATO) pending NADTC ATO approval.
- DTNG v3.1.3 baseline installed in the NADTC, NAS Oceana in May 2017.
- Funding received to develop and integrate simulation protocol adapters to support JSF training (Navy, United States Marine Corps [USMC], and UK) - July, 2017.
- Funding received to develop operational filtering rule set to support F-18 C/D training in FY-18.
- DTNG 3.1.0 baseline completed and submitted for ATO approval to support F-18 C/D training system. (December 2016)

ENVIRONMENT DESIGNED TO UNDERTAKE COUNTER A2AD TACTICS TRAINING & EXPERIMENTATION (EDUCAT2E)



Participants in Fleet Synthetic Training Research, Development, Test & Evaluation event



PROJECT DURATION
OCT 2014 - SEP 2018

OBJECTIVE

The current effort will participate in analyses, definition and development of human performance measures, standards and interfaces for use in the Navy Continuous Training Environment (NCTE), and in the development of constructive models. Live, Virtual and Constructive (LVC) demonstrations are planned throughout the effort to display technologies and capabilities and gain subject matter expert feedback.

VALUE TO THE WARFIGHTER

A need exists to ensure Carrier Strike Groups (CSGs) receive training on all aspects of Information Warfare assessed during certification including Command and Control in Denied and Degraded Environments (C2D2E). This program will help identify and fill training gaps for the fleet.

FUNDING SPONSOR
Office of Naval Research (ONR)

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DESCRIPTION

This S&T effort has two primary objectives:

- 1) Conduct analysis of multiplatform Electronic Warfare (EW) and Air Defense teams to understand how EW supports Air Defense & define roles/responsibilities, interdependencies, and multiplatform performance metrics
- 2) Define and develop synthetic, scenario based, distributed EW capabilities for Strike Group Electronic Warfare and Air Defense teams that can be used for both training and experimentation.

Outputs of this effort will support development of shore-based training technologies enabling training opportunities linked to both Basic and Intermediate Phase certification exercises.

NEED

Shore-based training events often lack inclusion of Information Warfare techniques preventing adequate exposure & integration within the Carrier Strike Group (CSG) prior to deployment certification. Thus, CSGs need training on all aspects of Information Warfare

including Command & Control in Denied & Degraded Environments during both Basic & Intermediate training phases to effective CSG integration during deployment.

BENEFITS

This enabling capability will advance Fleet operational proficiency and readiness in sensing and characterizing EMS activity to enable adaptation and freedom of maneuver in the EMS as a means to effectively operate in C2D2E at the individual, unit and Composite Warfare Commanders levels.

STATUS

The team is finalizing the Cognitive Task Analysis (CTA) to send to stakeholders and planning a workshop to validate paper-based measures of trainee evaluations with EW/IO subject matter experts (SMEs) at Tactical Training Group Atlantic (TTGL). The team will also participate in a tactical demonstration to showcase the capabilities within the Joint After Action Review-Resource Library (JAAR-RL) tool during a Fleet Synthetic Training (FST) like event and conduct experimentation.

KEY ACCOMPLISHMENTS

- Completed data collection with EW/IO instructor SMEs (MAR 2017)
 - Interviewed SMEs on both individual and team tasking, procedures, communication, and training
 - Identified training gaps (APR 2017)
 - Created task lists for EW personnel across surface and aviation platforms (APR 2017)
- Participated in a program review with ONR (MAY 2017)
- Authored a draft cognitive task analysis (CTA; SEP 2017)
- Created paper based measures for evaluating trainees during scenarios (SEP 2017)
- Met with SMEs and contracting partners at Tactical Training Group Atlantic (TTGL) to discuss data capture using the JAAR-RL tool, present metrics identified from the study, identify additional and missing information, and discuss additional future metric development requests (OCT 2017)

FLEET TRAINING TECHNOLOGIES (FleeT2)

PROJECT DURATION

NEW START

OCT 2017 - OCT 2022

OBJECTIVE

Currently, the Navy plans and trains for pristine Command and Control (C2) environments. While C2 is by itself complex, the emergence of peer threats makes it even more difficult to ensure resilient C2 processes. In a Denied/Degraded Environment (D2E), adversaries may deploy a variety of tactics that create a dynamic environment, rife with additional challenges. Training in the absence of these realities presents a threat to effective C2—a critical component of naval surface operations. FleeT2 will provide new training approaches and technologies.

VALUE TO THE WARFIGHTER

FleeT2 is designed to allow trainers to build scalable phenomenology models and virtual assets to train to emergent threats and technologies. The virtual constructive simulation capabilities planned for FleeT2 will allow the system to produce accurate, detailed, threat-dense, and intense scenarios that would be cost prohibitive or otherwise impossible to perform in the real world.

FUNDING SPONSOR

Office of Naval Research (ONR)

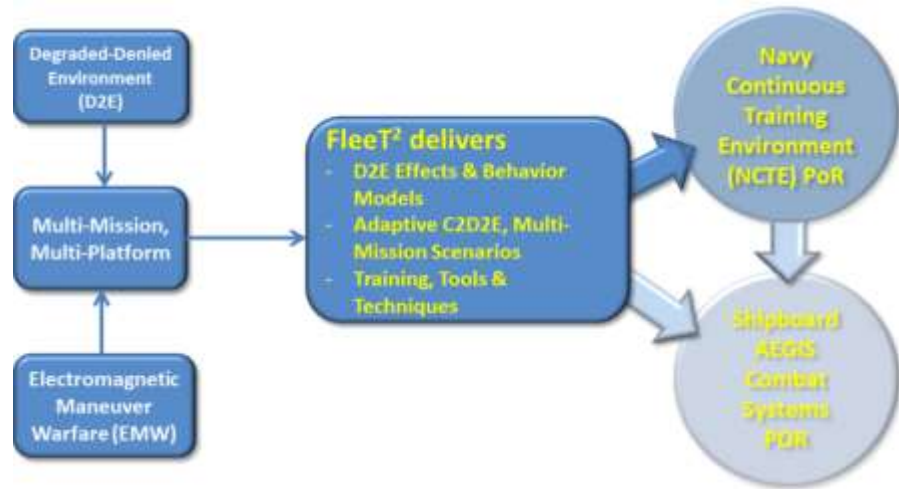
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DESCRIPTION

FleeT2 is designed to allow trainers to build scalable phenomenology models and virtual assets to simulate, test, and train to emergent threats and technologies. The virtual constructive simulation capabilities planned for FleeT2 will allow the system to produce accurate, detailed, threat-dense, and intense scenarios that would be cost prohibitive or otherwise impossible to perform in the real world. Synthetic models can be easily modified, repeated, and adapted to train various situations, user roles, and skill levels. Ultimately, FleeT2 will allow command teams and system operators to train for integrated, cross-platform warfare against simulated peer threats with counter D2 capabilities.

NEED

Naval surface Command and Control (C2) is a broad domain encompassing the management of coordinated electronic surveillance, information integration across enterprise sensors and information sources, and personnel/asset management in support of missions. Understanding all the demands facing C2 performers is further complicated by the fact that C2 personnel operate at many echelons of command and across many specialized functional areas.

Creating the training systems and curricula necessary to support such a domain will be challenging.

BENEFITS

There are two anticipated benefits arising from the FleeT2 program. First, the fleet will have a secure environment to train to address Denied/Degraded Environment (D2E) threats. Further, the simulations will be extensible to evolving and emerging threats. Second, the fleet will be able to train for D2E operations more effectively at a lower cost. This should result in a reduction in underway deployments required for training while providing an environment that mirrors the real world.

STATUS

FleeT2 is a new start Pre-Future Naval Capability effort. In FY18 a task analysis will be conducted for the Warfare Commanders to define concepts of operation in D2E, a preliminary set of performance measures for these teams, and a set of human computer interface mockups to support development of training tools.

KEY ACCOMPLISHMENTS

- A Technology Transition Agreement was signed between the Office of Naval Research (Code 341), OPNAV N96 (Director, Manpower and Training), Fleet Forces Command (N72), Program Executive Office Integrated Warfare Systems Integrated Training (1IT), and the Navy Continuous Training Environment, NSWC Corona (RS20F).

INTEGRATED WARFIGHTING CAPABILITIES (IWC) FIDELITY INVESTIGATION



DESCRIPTION

This effort consists of a three pronged approach to experimentation. First, a simulator analysis will be conducted. Analysis will include current Fleet training capabilities for high and low fidelity simulators will be conducted to ensure current Fleet capabilities can be appropriately replicated in the lab; and experimental assets that can replicate these capabilities as closely as possible. Next, development efforts will enhance any models that may be lacking in the selected assets. Finally, experimentation will be conducted to understand the impact of high and low physical fidelity when functional fidelity and instructional strategy are held constant.

NEED

Fleet training communities have begun to stand-up low fidelity training facilities (e.g., Air Defense Strike Group Facility [ADSGF], Fallon) to mitigate the maturity levels and issues associated with distributed SoS training. However, little research has been done to understand the impact these low fidelity devices will have on Training and Readiness (T&R) credit. This effort specifically seeks to address this need by identifying the impacts of physical fidelity on proficiency at multiple levels of the Strike Group using VC training.

BENEFITS

Findings will provide an understanding of the types of training objectives that can effectively be acquired using varying levels of physical fidelity. These findings can be applied to the broader IWC domain and to Live, Virtual, and Constructive training to provide insight on training system fidelity requirements. Additionally, this effort will provide empirical data associated with quantifying the amount of training required to acquire and maintain IWC skills in terms of learning and decay rates to better inform T&R and proficiency requirements.

STATUS

Analysis of current simulation capabilities both Fleet training and experimentation has been completed and experimental assets identified. Enhancements to ownship weapons model for the high fidelity simulator at Manned Flight Simulator are currently underway, and the first iteration of verification and validation completed with Fleet Subject Matter Experts. The development team is currently updating the models based on Fleet feedback and another round of testing is schedule for November. Experimental planning is currently underway.

PROJECT DURATION

OCT 2016 - SEP 2018

OBJECTIVE

This effort seeks to identify the impacts of physical fidelity on proficiency. Specifically, this effort will investigate the level of physical fidelity required to train various Naval Integrated Fire Control - Counter Air (NIFC-CA) specific tasks and skills identified by the PMA-205 funded Front End Analysis (FEA). Findings from this effort will provide empirical data to inform training requirements.

VALUE TO THE WARFIGHTER

Findings from this effort will inform existing training at facilities like the Advanced Strike Group Facility and future training procurements (i.e., E-2D Weapons School, F/A-18 Air Wing, Tactical Training Group Atlantic/Pacific, Naval Aviation Simulation Master Plan II) by identifying the training objectives that can effectively be trained using systems of varying physical fidelity.

FUNDING SPONSOR

Naval Air Systems Command
(NAVAIR) | Section 219

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KEY ACCOMPLISHMENTS

- Observations of training conducted at Advanced Strike Group Facility completed
- Analysis of training systems report in preparation
- First iteration of weapons model development tested with Fleet SMEs
- Analysis of instructional strategies for multi-team training report in preparation

MODULAR ADVANCED TECHNOLOGIES MARKSMANSHIP PROFICIENCY

PROJECT DURATION

MAY 2016 - SEP 2017

OBJECTIVE

Provide five (5) Mk3+ prototype Modular Advanced Technologies Marksmanship Proficiency M16A4 Rifle kits to Weapons and Field Training Battalion Parris Island for long term field evaluation.

VALUE TO THE WARFIGHTER

- Provides instructors with additional direct measures to assess problem shooter performance
- -Reduces instructor workload by helping to focus attention on the root cause(s) of deficient performance
- -Increases probability of problem shoot qualification

FUNDING SPONSOR

Marine Corps Systems Command
(MARCOR SYSCOM)

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DESCRIPTION

MAT-MP is a reconfigurable small arms instrumentation kit used to assist in the assessment and diagnosis of problem shooter performance at the rifle range. It consists of modular sensors that can be temporarily attached to a rifle platform in less than five minutes. These sensors stream wireless data back to a software-based instructor assistant application hosted on a tablet computer. This includes a camera unit attached to the rear eyepiece of the combat optic providing visual evidence of aim point and hold for each shot. A replay feature gives instructors the option to step through the video/data frame by frame and compare different shots side-by-side.

NEED

Basic marksmanship training can consume a large number of resources. Approximately 15-20% of trainees that are problem shooters can consume 50% or more of these training resources. Rapid and accurate identification

of performance problems is essential to reducing the total cost this training. Instructors can be better supported with access to direct performance measures on key marksmanship concepts (trigger control, aim point, hold, stability, breath control, etc.) to help increase the probability of problem shoot qualification.

BENEFITS

MAT-MP provides instructors at the Known Distance range a kit of tools to assist in the assessment and diagnosis of problem shooter performance. The shooter's performance can be assessed using his table of order rifle and zero. Visualization of the video and data provide additional objective measures of shooter performance beyond fall of shot. This additional instructor support can help reduce the number of re-shoots, failed qualification attempts, and re-cycles of problem shooters. These are both student and instructor time saving metrics. MAT-MP data can also assist instructors in identifying possible curriculum improvements and student consistency across classes.

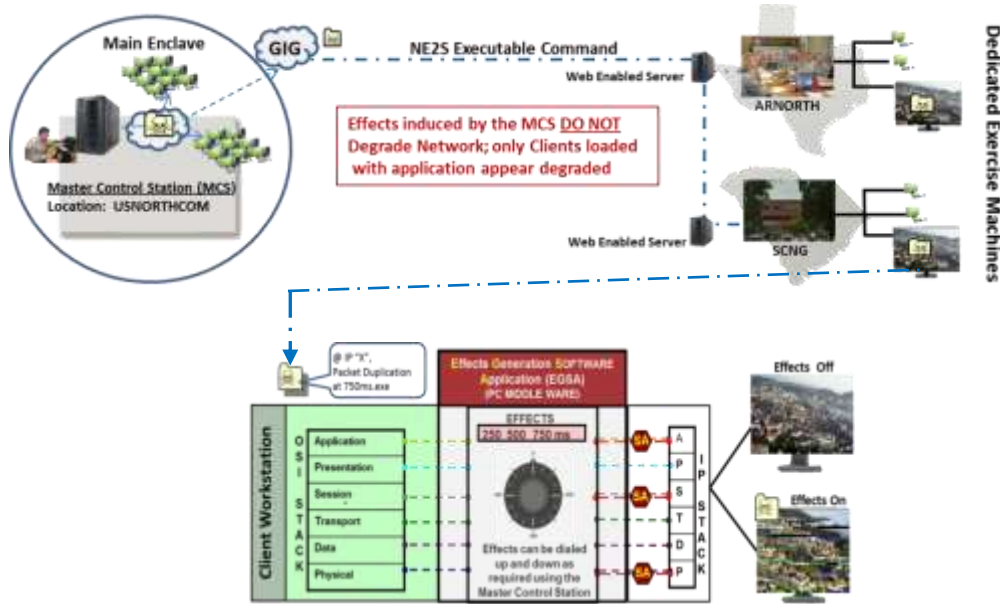
STATUS

MAT-MP was previously developed as an advanced demonstration under sponsorship by the Office of Naval Research Code 30 Human Performance, Training and Education portfolio. The Mk1 version of the kit was field tested in April 2014 with Marines from Weapons Training Battalion, Quantico. Mk2 version of the kit was demonstrated in December 2014. An expanded capability Mk3 version of the kit was tested in October 2015 at the Federal Law Enforcement Training Center. Five Mk3+ prototype kits were deployed to Recruit Depot Parris Island for extended field evaluation in January 2017. The technology is patent pending.

KEY ACCOMPLISHMENTS

- Deployed five (5) MAT-MP Mk3+ M16A4 rifle kits to Weapons and Field Training Battalion Marine Corps Recruit Depot Parris Island January 2017
- Provided field updates to the five systems in April 2017
- Two (2) of the five prototype kits were transferred to Edson Range Camp Pendleton for evaluation by Weapons and Field Training Battalion Recruit Depot San Diego August and September 2017

NETWORK EFFECTS EMULATION SYSTEM (NE2S)



DESCRIPTION

The NE2S software provides support to various distributed sites and terminal/systems. By simulating network and host based effects, NE2S enables the Testing, Training and Experimentation communities to create a wide range of conditions under which applications and systems can be tested (i.e., Cyber for Cyber) improving event reality. NE2S provides realistic training capability during events or exercises whether local or distributed.

NEED

The Test and Evaluation (T&E)/Science and Technology (S&T) Net-Centric Systems Test (NST) program exploits new technologies and processes to meet important T&E requirements; expedites the transition of new technologies from the laboratory environment to the T&E community; and leverages commercial equipment, modeling and simulation, and networking innovations to support T&E.

BENEFITS

The Network Effects Emulation System (NE2S) provides realistic emulation of network and host-based cyberspace attacks. NE2S integrates traditional test and training environments with cyber-attack scenarios. The Master Control Station (MCS) affords centralized control of real time, instructor-initiated effects, or scripted scheduled scenarios. NE2S employs a network-centric architecture and currently supports Linux and Windows operating systems.

STATUS

This project will be utilized in several military exercises in the upcoming future. More software upgrades and improvements are planned for the next year.

PROJECT DURATION

SEP 2014 - SEP 2018

OBJECTIVE

The objective of this project is to research and develop a cost effective, enterprise tool for the Net-Centric Systems Test (NST) and training and experimentation communities capable of simulating a wide range of network and host based effects that can be centrally managed and controlled.

VALUE TO THE WARFIGHTER

The Test and Evaluation (T&E)/Science and Technology (S&T) NST program exploits new technologies and processes to meet important T&E requirements; expedites the transition of new technologies from the laboratory environment to the T&E community; and leverages commercial equipment, modeling and simulation, and networking innovations to support T&E.

FUNDING SPONSOR

Naval Aviation Training Systems
Program Office (Program
Management Activity [PMA] 205)

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KEY ACCOMPLISHMENTS

- A NE2S prototype system is being used in daily operations for the U.S Army Training and Doctrine Command (TRADOC) Training Brain Repository, as well as the South Carolina National Guard and Army.
- Over the past year, the focus was on working on software upgrades.
 - Specifically, the NE2S system was upgraded to Windows 10 for all host and client machines.
- Other enhancements include
 - enhanced After Action Reporting Capability
 - more targeted network effects
 - interoperability (web Application Program Interface (API), simulation protocols)
 - effects editor
- NE2S 2.0 includes a web-based server for the Master Control Station (MCS) and automatic workstation reporting.

REAL-TIME RF PROPAGATION MODELING IN URBAN ENVIRONMENTS

PROJECT DURATION

★NEW START★
OCT 2017 - SEP 2019

OBJECTIVE

The Training Systems Division (TSD), Concept Development and Integration Laboratory (CDIL), will conduct research into the development of a physics-based, multipath Radio Frequency (RF) model for urban environments. To add realism to RF tactical communications in urban settings for Virtual and Constructive (VC) synthetic training exercises, the goal is real time execution of the RF propagation model.

VALUE TO THE WARFIGHTER

The results of this basic research, implemented in software with a goal of executing in real time, has the potential to bridge the gap between a lack of RF tactical communications realism to potentially valuable, real-world training in virtual and constructive domains.

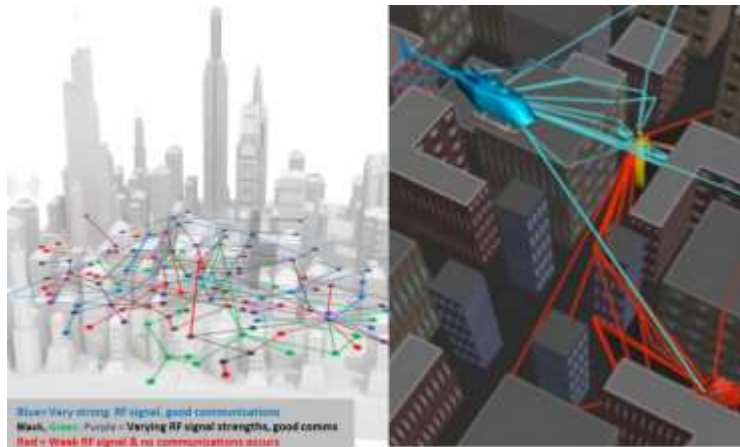
FUNDING SPONSOR

Naval Air Systems Command
(NAVAIR) | Section 219

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Modeling RF in Propagation in an Urban Environment

DESCRIPTION

The team will investigate computational algorithms for modeling highly-complex RF propagation and signatures (reflectivity, absorption, diffraction, etc.) in urban environments for application to moving platforms in Virtual and Constructive (VC) training simulations. This is a multi-part evaluation to assess current RF multi-path modeling execution limitations against the benefits of new technology methods currently applied in other application areas vs. the development of a new computational method to rapidly identify dominate ray paths in RF multi-path propagation modeling.

NEED

Current VC modeling, widely used for distributed synthetic training environments, does not satisfy RF tactical communications training fidelity realism to match operational conditions of the live-physical domain.

Presently during training exercises, live radio operators, on virtual radios, always receive a strong RF tactical communication signal, despite virtual operational positions separated by great distances. The constant strong signal reception does not prepare the Warfighter to address operational situations with a weak or block RF signal.

BENEFITS

The benefit of this research is to improve training for the Warfighter in the area of RF communication in urban environments.

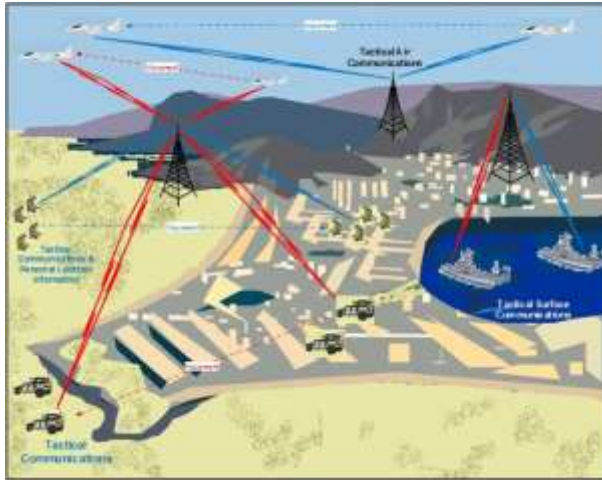
STATUS

This effort was selected as a FY18 start.

GOALS FOR FY18

- Investigate urban structures sources and formats
- Survey capabilities of current RF multipath modeling
- Assess limitations of current RF multipath modeling
- Benchmark execution times of existing software techniques
- Develop software methodology to link building characteristics to individual buildings
- Develop methodology to incorporate building characteristics and structures into modeling software

SCRIPTING AND SEQUENCING CONTROL COMPONENTS WITHIN ELECTROMAGNETIC SPECTRUM PROFICIENCY MODELING



Live, Virtual, Constructive (LVC) Exercise: Modeling Red Force and Blue Force Radio Frequency Communications for a Realistic Information Operations Contested Mission

DESCRIPTION

Common Scripter has demonstrated the capability to provide an Opposition Force Electromagnetic Maneuver execution for an Information Operation (IO) contested mission. Integrating Radio Frequency (RF) propagation loss models into Common Scripter will provide an accurate, real-world presentation of the electromagnetic operational environment for a LVC mission.

NEED

Presently, the Common Scripter project simulates a contested IO environment for LVC missions. However, simulated signals are transmitted at arbitrary, preset RF signal strengths and do not prepare Decision Markers, or the Warfighter, to strategically manage real-time Electromagnetic Spectrum operations, especially for mobile entities.

Focus Areas: Electromagnetic Maneuver Warfare (EMW) / Live, Virtual, & Constructive (LVC) Environments.

BENEFITS

- 1) Cost Efficient - The system runs automatically and in real time from a single workstation and is controlled by a single operator.
- 2) Simulated Realism - Executes an IO contested LVC mission in a realistic, effective manner across training ranges.
- 3) Logs transmission events for After-Action Review

STATUS

This effort was selected as a FY18 start.

PROJECT DURATION

NEW START
MAR 2018 - SEP 2019

OBJECTIVE

The concept of this investment is to incorporate and leverage electromagnetic spectrum modeling into "Common Scripter", a centralized scripting and sequencing control. By moving to a model-based, operationally relevant system, the expertise to simulate Blue Force and Red Force live radio communications is transferred to distributed environments for realistic, Live, Virtual, and Constructive (LVC) Electromagnetic Spectrum Operations (ESO).

VALUE TO THE WARFIGHTER

Fleet Impact: The mission importance and value to the Naval Warfighter is an accurate, real-world presentation of Blue Force and Red Force contested ESO for increased realism in LVC distributed exercises.

FUNDING SPONSOR

Naval Air Systems Command
(NAVAIR) | Section 219

POINTS OF CONTACT

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LCDR Rolanda Findlay (PM)
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GOALS FOR FY18

- Interface design between existing Common Scripter and selected RF propagation model
- Graphical User Interface(GUI) design
- Systems Requirement and Test Plan Document
- Design and in-house Preliminary Design Review (iPDR)

VERIFICATION AND VALIDATION OF HIGHER FIDELITY CONSTRUCTIVE ENTITIES FOR UAS TRAINING

PROJECT DURATION

★ NEW START ★
OCT 2017 - SEP 2020

OBJECTIVE

This research effort will (1) assess the impact of using live data within the Next Generation Threat System (NGTS) to improve training realism and fidelity of constructive entities and to verify the gains in training effectiveness and efficiency that result for UAS operators and Naval Aviators and (2) create a controlled training effectiveness evaluation (TEE) process that can be replicated and generalized to component trainers across domains.

VALUE TO THE WARFIGHTER

The results of this research will be used to create a guiding document on current and future UAS training using an existing training system and can also be generalized to predict the impact on training effectiveness and operator workload for future implementation of more realistic, easier to use SAF and constructive technologies.

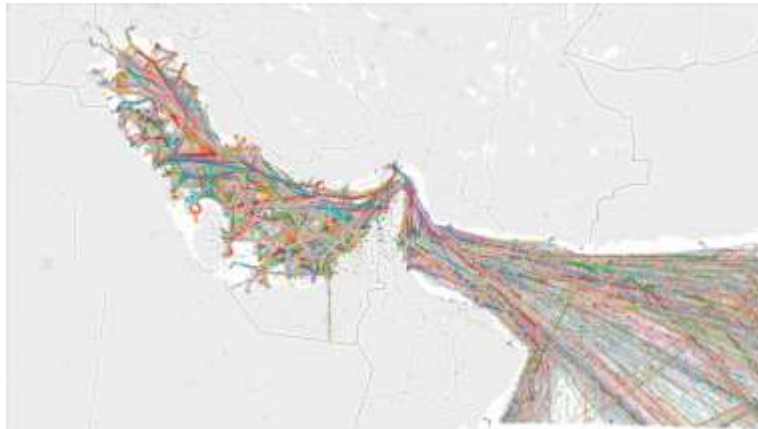
FUNDING SPONSOR

Naval Air Systems Command
(NAVAIR) | Section 219

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Raw input data reflecting real-world, white shipping behavior. This data helps to quickly populate scenarios, reducing operator workload.

DESCRIPTION

Utilizing science of learning research principles, we will empirically evaluate the effects of higher fidelity training stimuli on performance. Using the Dynamic Adaptive and Modular Entities for UAS (DYADEM) capability, we will conduct a controlled experiment with the fleet to test our hypotheses (investigating trainee reactions, learning gains, and reported workload), collect quantitative/objective data, and create a method of assessing a capability meant to improve a training system without adding training content. Specifically, we wish to explore the effects of the new capability on performance, distinct from the NGTS training content.

NEED

Currently, the impact of the DYADEM capability on learning and performance has yet to be investigated or verified. This is due both to a lack of experimental control in applied/operational training settings as well as a lack of process or methodology that is needed to scientifically and systematically test the training effectiveness of technology that

does not add additional training content but rather enhances current training fidelity.

BENEFITS

The impact of the proposed work will improve training not only for UAS but for P-8 and Triton, increase NGTS capabilities, inform training decisions, and predict what the impact will be on the fleet community as well as determining the return on investment for component training. The findings from this research will be used to drive future TEE studies to show value in Naval training capabilities. Additionally, this research offers guidance for LVC Test and Training to optimize individual and collective test and training capabilities through development, expansion, and refinement of live-virtual-constructive capabilities across test and training environments, learner populations, and across domains, systems, and security levels.

STATUS

This effort was selected as a FY18 start.

GOALS FOR FY18

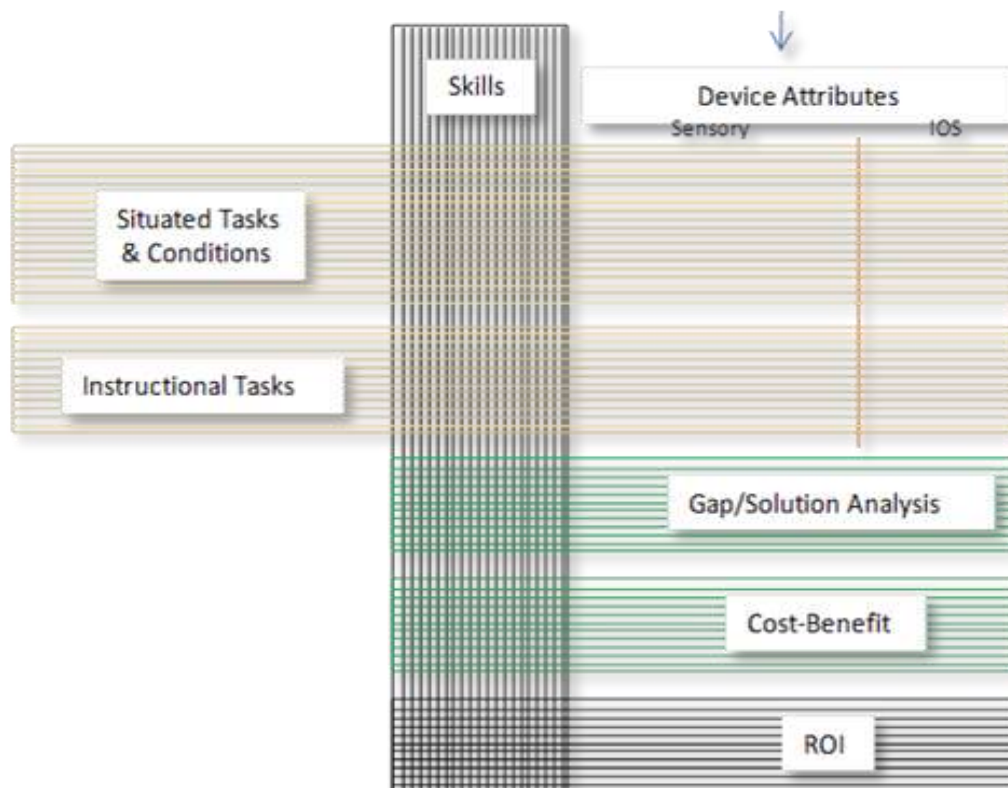
- Determine how to tease out the impact of realism on training
- Design an additive values study
- Design a measure to assess operator workload for instructors

CORE CAPABILITY 4: HUMAN SYSTEMS ANALYSIS, DESIGN, AND EVALUATION

AIR-4.6 supports and improves human performance through the analysis, design, evaluation, and acquisition of cost-effective training solutions that are both responsive and proven to meet learning, performance, and readiness requirements. This capability is utilized across aviation, surface, undersea and cross warfare domains. Through the application of analytical methods, grounded design theories, and instructional design principles, analysts conceptualize, evaluate, and optimize the design and implementation of training systems and pipelines.

The following Technology areas comprise this Core Capability:

- High-Fidelity Training Environments
- Courseware Design
- Training Optimization Analysis
- Training Effectiveness Evaluation (TEE)



UTILITY AND EFFECTIVENESS OF USING FLEET-PRODUCED MAINTENANCE VIDEOS AS JOB PERFORMANCE AIDS

PROJECT DURATION

★ NEW START ★
OCT 2017 - SEP 2018

OBJECTIVE

The objective of this proposal is to evaluate the utility and effectiveness of using Fleet produced maintenance videos as job performance aids (JPA) on complex maintenance tasks. An empirical study will be conducted to assess maintainer proficiency and satisfaction on a selected maintenance task utilizing a tablet-based Maintenance Ready Card with embedded video, compared to a control condition utilizing a tablet-based MRC without video.

VALUE TO THE WARFIGHTER

The current effort will investigate the potential benefits of streamlined video development processes and tools, and enhanced JPAs to improve maintainer proficiency. Developing a standard video development procedure will allow Code 6.0 to tie into the digital thread effort by providing the fleet with a JPA that will greatly enhance safety and maintainability.

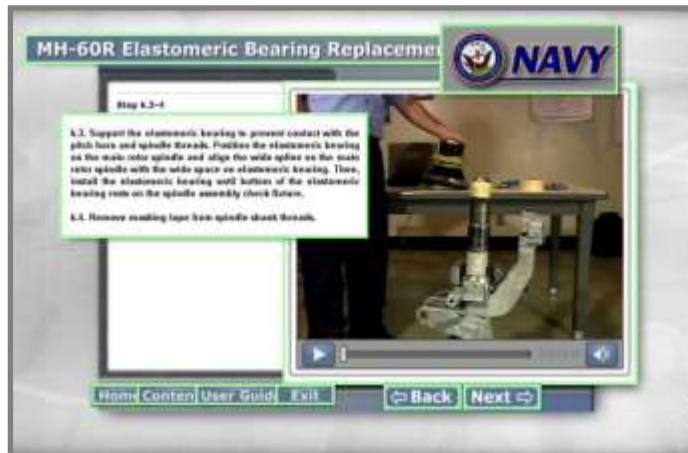
FUNDING SPONSOR

Naval Air Systems Command
(NAVAIR) | Section 219

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Example of video as a Maintenance Job performance aid

DESCRIPTION

The proposed research effort will focus on the following primary activities:

- 1) Process and governance for Fleet produced video development and sharing
- 2) Guiding principles and best practices in instructional design and human factors for video creations and content development
- 3) Development of video content and experimental prototypes
- 4) Empirical evaluation of the impact of videos as JPA on maintenance task performance and utility considerations

NEED

Integrated Logistics Support (ILS) STO-2 calls for improved maintenance capabilities to address the increasing complexity and costs of maintaining aircraft systems. Further, technologies and tools are needed which enable the rapid integration of support equipment and maintenance practices through reduced maintainer workload and turnaround times.

BENEFITS

This project involves the development of a video generation process and guidelines to help provide the Fleet maintainer with visual aids to help with complex maintenance tasks. The video generation process currently does not exist and instances of unauthorized maintenance videos have been routinely emerging to help bridge a gap. This effort is attempting to curb that practice and put in place common sense practices for the creation of these videos that follow governance covering official validation and verification and configuration management processes.

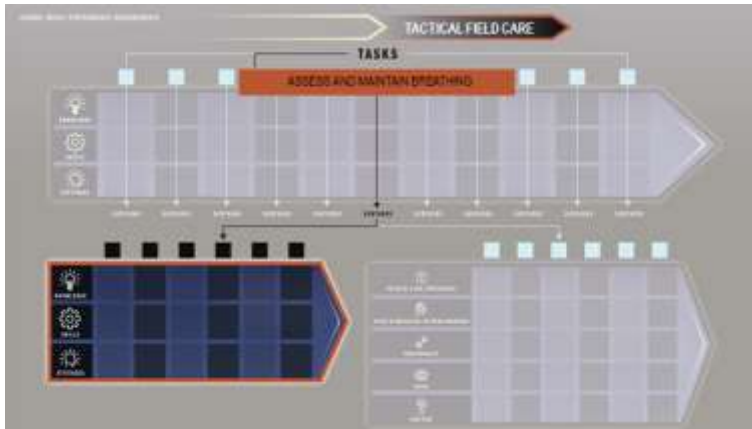
STATUS

This project was started in October 2017 (start of FY18). Efforts to be completed by the end of FY18 will focus on 1) creation of video content and tablet-based prototypes for empirical study, 2) submission and approval of protocol by IRB, 3) execution of empirical study, and 4) development of video production guidelines.

GOALS FOR FY18

- Final technical report to be published
- Video Template and How-To Manual for Fleet use to be developed
- Configuration Management Plan and Verification & Validation procedure for Video Content to be developed
- Tablet-based prototypes (with and without embedded videos) to be developed
- Mentoring of local NAWCTSD Entry-Level Employees (ELEs) on this project exposing them to Fleet maintenance tasks and analysis

MEDICAL TRAINING VALIDATION 2 (MTV2)



Task requirement visualization template

DESCRIPTION

A tactical combat casualty care performance model was developed to reflect the tasks and knowledge, skills and attitudes required to train tactical combat casualty care in a combat environment. The model describes not only the medical tasks to be performed but also concurrent task requirements such as maintaining situation awareness and communicating to team members which are essential components of success on the battlefield. The performance model served as the foundation for identifying cue requirements and gaps, and generating performance metrics. Intuitive graphics were created specifically to support communication of the training requirements to various stakeholder groups.

NEED

It is essential that combat medics receive proper training before they enter the battlefield; therefore it is critical that the training requirement is defined fully; limitations of training media to meet those requirements are identified; and the efficacy of existing training media can be determined via empirical research using validated metrics.

BENEFITS

This effort provides detailed training requirements (tasks, knowledge, skills, attitudes, and cues) to inform the development of higher fidelity training situations and media. This effort will also identify gaps toward which to strategically invest simulation and technology research and development dollars. It also offers metrics for use in empirical research examining training media efficacy which can influence curriculum optimization and acquisition decisions.

STATUS

Although this project has ended, the products of this effort will continue to be refined and used by/ in conjunction with another DHA funded project, Medical-Proficiency Modeling (Med-PM). Med-PM is a Medic/Corpsman proficiency modeling tool providing stakeholders with the capabilities to:

- 1) examine simulation based training system capabilities and gaps,
- 2) conduct trade space analysis,
- 3) generate training requirements,
- 4) provide meaningful visualizations of requirements and analysis results to users.

Valid performance metrics will be used to validate the model and its predictions.

PROJECT DURATION
DEC 2016 - SEP 2017

OBJECTIVE

The goal of the MTV2 effort was two-fold, focusing on two combat medic tasks, amputation and needle chest decompression: 1) identify training requirements as well as gaps in existing simulation-based training media, and 2) develop performance metrics to support performance assessment in simulation comparison research.

VALUE TO THE WARFIGHTER

This effort has the potential to lead to improvements in medical simulators and simulation based training for Combat Medics/Corpsmen.

FUNDING SPONSOR

Defense Health Agency (DHA) |
Joint Program Committee (JPC)-1

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KEY ACCOMPLISHMENTS

- Developed a Tactical Combat Casualty Care performance model that:
 - Identifies tasks and KSAs from point of injury through preparation for evacuation.
 - Identifies additional performance characteristics associated with desirable outcomes.
 - Deep dives needle chest decompression and amputation management
 - Requirements visualizations.
- Documented cue requirements and gaps.
- Performance measures for needle chest decompression and amputation management medical procedures.

DISTRIBUTED, ADAPTIVE, AND MODULAR ENTITIES FOR UNMANNED AERIAL SYSTEMS (DyAdEM)

PROJECT DURATION MAR 2014 - MAR 2018

OBJECTIVE

The primary objective of the project is to enable realistic and increasingly intelligent white force activity in tactically plausible scenarios by developing, at appropriate scales, computer generated force (CGF) to act in them in realistic, complex, Patterns of Life (PoL). The long-term objective is that the CGF behaviors will be dynamic, allowing for tactically-realistic and contextually relevant performance that requires minimal operator guidance to develop, modify, and maintain.

VALUE TO THE WARFIGHTER

Ease and flexibility in creating training scenarios would be beneficial to all training systems but is specifically applicable to UAS due to their evolving capabilities and tactical mission utilization. , it will provide a more realistic and effective training experience and the resultant simulated forces will require less input from instructors, reducing support costs.

FUNDING SPONSOR

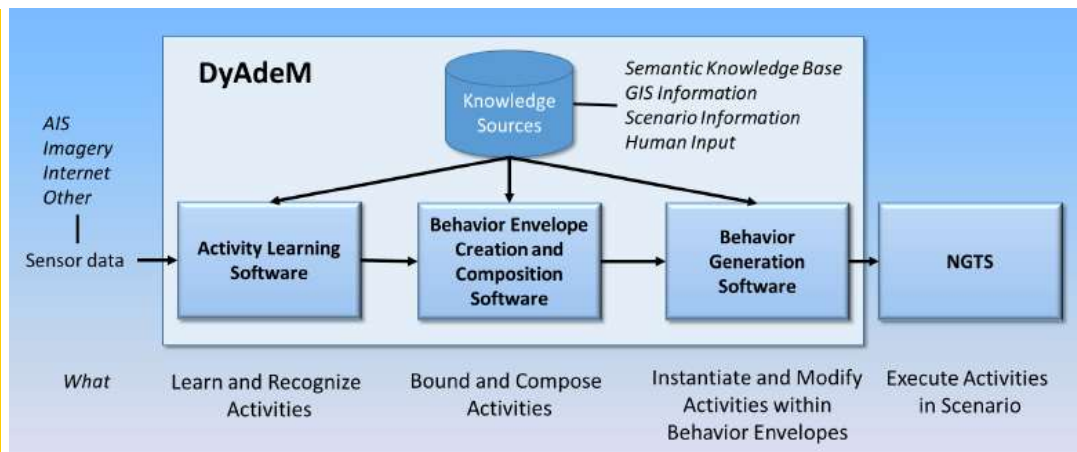
Office of Naval Research (ONR)

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DESCRIPTION

DyAdEM includes replacing hand-coded rule sets with a capability to automatically generate new and appropriate CGF behaviors from one or more data sources including: data captured during live UAS exercises; data captured from experts operating their systems within a simulated environment; or data provided in a script-like format. On final delivery, the DyAdEM product will deliver a software based content generation capability that converts "raw" data (captured during live exercises, recorded during actual missions or generated from live range testing) into realistic CGF behaviors that will populate training scenarios.

NEED

DyAdEM will deliver the tools, standards, and guidelines to generate large numbers of realistic semi-automated force (SAF) or computer generated force (CGF) behaviors in a format that can be integrated into the Navy's SAF generation technology, the Next Generation Threat System (NGTS). The

primary requirement of this product is to aid the integration of hundreds, if not thousands, of simulated entities into the overall training scenario that aviation requires.

BENEFITS

DyAdEM will create more realistic patterns of life for entities within training scenarios, thus creating more realistic and effective training. It will also save time by reducing operator workload by using real world data to generate scenario content on the fly.

STATUS

DyAdEM is in the final year of the program. The team is working to acquire and analyze raw data, complete the deliverables, and run a verification and validation study looking at system effectiveness. Period of performance ends MAR2017.

KEY ACCOMPLISHMENTS

2017 Products

- Delivered a data package to ONR that included:
 - Realistic Pattern of Life waypoints
 - Software that generates NGTS Route Objects (NRoute) for use by entities at scenario start
 - Improved scenario start files
 - System that generates realistic, computationally simple Pattern of Life behavior specifications for distracter entities
- Interim Program Reviews (IPRs) and Technical Information Meetings (TIMs) FEB 2017 and AUG 2017

EFFECTIVENESS ASSESSMENTS OF MIXED & IMMERSIVE REALITY FOR AVIATION TRAINING



Sample Augmented Reality headset used for testing toolkit

DESCRIPTION

Augmented reality (AR) has been on the cusp of ushering in a training paradigm shift for over a decade by allowing overlays of a digital world on real platforms. Although the Navy and industry counterparts have been exploring the value of using AR technology in training, few rigorous measurements of effectiveness have been conducted of AR itself, as well as comparing it to other related training technologies. Yet, as technology improves, AR remains a promising training capability as it enables embedded “train as you fight” training. The Navy is seeking an analysis tool grounded in a methodology that supports comparison of AR and alternative solutions for a representative training environment.

NEED

The resulting tool will include development of generalizable, best-of-breed methodology that will allow researchers to quantify the effectiveness of modern AR training and how AR training performance compares to related technologies. This effort focuses on delivering

a rigorous measurement of effectiveness of AR and ability to calculate return on investment or design solution tradeoffs of comparative technologies.

BENEFITS

The development of a tool that has the capability to measure the training effectiveness, comparable utility, and return on investment of an augmented reality solution for applied training task.

STATUS

Performers have identified feasibility solutions and produced early rapid prototypes for AR and alternative training solutions (e.g., handheld tablet training, game-engine based virtual environment training) for aviation training. Performers have started experimental design planning, including identification of applicable methods of assessing effectiveness, utility performance comparisons, and return on investment analyses for studies in Phase 2.

PROJECT DURATION

MAY 2015 - MAY 2018

OBJECTIVE

To develop a methodology that results in a capability to investigate the training effectiveness, comparable utility, and return on investment of an augmented reality solution for applied training task.

VALUE TO THE WARFIGHTER

The resulting tools and guidance will increase mission capabilities by providing platforms research-based support to make their training decisions related to cutting edge technologies, such as augmented reality. By using the optimal training technology solution, it can also reduce life-cycle costs, as using a more ineffective approach produces less effective training.

FUNDING SPONSOR

Naval Air Systems Command
(NAVAIR)

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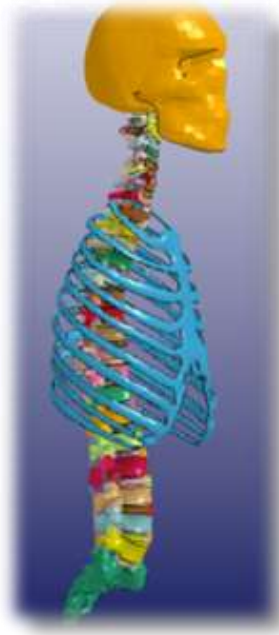
GOALS FOR FY18

- Demonstrate feasibility for the development of AR and alternative training solutions (e.g., handheld tablet training, game-engine based virtual environment training) for a representative training task
- Research and evaluate and create an experimental design plan, including identification of applicable methods of assessing effectiveness, utility performance comparisons, and return on investment analyses

CORE CAPABILITY 5: WARFIGHTER PROTECTION, PERFORMANCE, AND SURVIVABILITY

AIR-4.6 uses an underlying human-centered philosophy to enhance warfighter and maintainer protection, performance to reduce the risk of injury through the use of a systems approach for the development of protective ensembles, equipment and performance force multipliers. AIR-4.6 applies the principles of human systems integration to ensure that concept development addresses total system performance and the use of human engineering to ensure that both mission effectiveness and safety are key success criteria. For this discussion, "Protection" is defined as reduced vulnerability to all injury mechanisms; "Performance" includes skills that result in increased ability or lethality, and enhanced "Survivability" results in decreased combat casualties.

Warfighters endure a wide range of physical, cognitive, emotional, and physiological stressors during normal operations and even more so during missions and active combat. Stressors include long duration missions in extreme climates, hazardous noise, maneuvering and impact acceleration, vibration and shock forces, and frequent altitude changes. Combat injuries occur not only from kinetic threats leading to internal organ and musculoskeletal injuries, but risk mitigations are needed for health/safety hazards, e.g., drowning, burns, falls, chemical/biologic/radiologic exposures, noise, and exposure to allergens. Historically, life support systems (LSS) development programs addressed these issues as largely independent challenges. When development was uncoordinated (lacking design agreement between supporting groups), the resulting LSS were often bulky, heavy, hot,



and had adverse impacts on other human performance survivability factors, e.g., crashworthiness and/or ejection. Poor LSS design encumbers the warfighter, contributing to fatigue, distraction, and ultimately decreased mission performance/effectiveness. Furthermore, some LSS designs inflicted unintended adverse consequences, such as digital night vision goggles (NVG) and devices, as well as helmet mounted devices (HMD). These performance force multipliers clearly enhance mission performance but can result in neck, back pain, reduced cervical range of motion, and increased injury risk during aircraft ejection or crash. Modern seating systems perform their primary function well. However, the seats were designed for impact protection and do not necessarily provide ergonomic support to warfighters for extended 5+ hour operations. Lack of attention to ergonomics often contributes to chronic musculoskeletal pain and injury of Warfighters.

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CORE CAPABILITY 5: WARFIGHTER PROTECTION, PERFORMANCE, AND SURVIVABILITY

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Through a coordinated use of integrated casualty prediction modeling, development, and testing, AIR-4.6's human-centered LSS design became efficient and agile, thus enabling a rapid response to the dynamically changing needs of coalition and irregular warfare (IW) personnel. This integrated approach includes quantifying human responses to exposure to various combinations of environmental stresses; determining injury mechanisms; developing verified and validated computational, kinematic, and physical models to describe and predict the response to stressors and quantifying injury risk; exercising these modeling tools to provide design criteria for performance force multipliers; using advanced testing methodologies to develop design criteria that account for individual tolerance differences; and creating and validating mitigation technologies and strategies that both optimize performance and reduce risk.

Each project tackles stratified issues of sex, age, and anthropometric accommodation, so that all warfighters are optimized for combat and not just a select portion of the total population.

AIR-4.6's human-centered LSS goal is to furnish personnel with systems that maximize protection and enhance performance in the full spectrum of combat environments while minimizing chronic and traumatic injury. These transformational warfighting enhancements will enable warfighters to not only overcome environmental threats and respond to ever-expanding mission demands and platform capability growth, but to dominate in all dimensions of the battlespace environment.

The following Technology areas comprise this Core Capability:

- Determine Injury Mechanisms
- Develop Injury Prevention and Mitigation technologies
- Ensure Warfighter and Support Personnel Accommodation
- Develop/Evaluate Electro-Optical (EO) Sensors, Displays, Interfaces and Devices
- Develop Equipment and Procedures Related to Aircraft LSS Performance, and Maintainability

CONSTRUCT CORRESPONDENCE OF PHYSIOLOGICAL AND SUBJECTIVE MEASURES OF HYPOXIA

PROJECT DURATION

OCT 2016 - SEP 2018

OBJECTIVE

This project seeks to evaluate the relationship between extant physiological measures and subjective measures of hypoxia symptoms in order to better understand physiological hazard report data from aviators and improve hypoxia awareness and mitigation training.

VALUE TO THE WARFIGHTER

- Disentangle physiological and subjective symptoms, while documenting individual differences that influence susceptibility
- Validation of subjective responses to hypoxia against physiological responses to enable better interpretation of symptomology

FUNDING SPONSOR

Naval Air Systems Command (NAVAIR)

POINTS OF CONTACT

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Tedd Muery, center, a T-45 simulator instructor, and LCDR Thomas Jones, a physiologist from Chief of Naval Air Training, give dynamic hypoxia training to 1st Lt. Gregg Borman, a Marine student naval aviator assigned to Training Squadron (VT) 22. The hypoxia training involves a reduced oxygen breathing device which exposes aircrew to actual hypoxic conditions.

DESCRIPTION

To evaluate the relationship between extant physiological measures and subjective measures of hypoxia symptoms in order to better understand physiological hazard report data from aviators and improve hypoxia awareness and mitigation training. The study will focus on collecting both subjective and physiological measures of hypoxia, as well as demographic data and individual difference factors to determine how these factors affect specific hypoxia criteria. Outcomes of this research can help us decipher which subjective measures of hypoxia are actually products of demographic and individual difference factors and which demographic and individual difference factors.

NEED

The proposed research has several key, direct benefits for NAWCTSD/NAVAIR, thrust areas and the NAE. Validation of subjective responses to hypoxia against physiological responses to enable better interpretation of HAZREP data and inform future surveys to capture reports. Facilitate a better understanding of individual difference/demographic factors that influence

susceptibility to subjective responses to hypoxia to inform training enhancements and inform potential predispositions in individuals.

BENEFITS

Understanding hypoxia, its symptoms, and how to effectively train aviators to recognize those symptoms will save lives. Hypoxia is a prevalent issue and is a key factor of aviation mishaps for Naval aviators. Understanding who experiences hypoxia and when will increase the fidelity of training as well as be a preventative safeguard against mishaps.

STATUS

Currently, research psychologists are performing observations in order to understand the problem space and begin to parse out the differences between reported subjective symptoms and objective measures. An Institutional Review Board protocol is in progress including signed letters for data collection at fleet sites including the Navy's Aviation Survival Training Centers and the Naval Air Training command (CNATRA); following acceptance, research protocols will begin. Final results will be available at the end of FY18.

KEY ACCOMPLISHMENTS

- Presentations:
 - E. Anania, Dr. M. Tindall, B. Atkinson, (2017, October 31). *Investigation of Hypoxia Training: Do Trainees Accurately Recognize Symptoms*. Presented at SAFE Symposium, Orlando, FL.
 - T. Cooper, Dr. M. Tindall, B. Atkinson, (2017, October 31). *Manifestations of True Hypoxia: Drawing the Distinction between Real Symptoms and Symptoms that Mislead*. Presented at SAFE Symposium, Orlando, FL.
- Collaborative Mechanisms/Agreements:
 - Investigating Cooperative Research and Development Agreement (CRADA) with Cobham Mission Systems to acquire physiological sensing capability.
 - Received letters from Chief of Naval Air Training (CNATRA) and Naval Medical Operational Training Center to recruit participants and conduct research with on-site Aerospace Physiologists.
 - Collaborating with NAWCAD for use of physiological sensors.
- Workforce Development:
 - Mentor junior teammates and provide opportunities for observation of hypoxia awareness and mitigation training events.

FIREFIGHTING TRAINER MODIFICATION AND ENHANCEMENT



DESCRIPTION

This research seeks to investigate feasibility of an analysis that documents the current methods used for manipulating stressors, as well as current methods for instructors to determine trainee stress levels, how and when to modify stress cues, and strategies for identifying and eliminating or mitigating excessive trainee stress. This task analysis will build on previous efforts conducted under the DHS SBIR with DHS component representatives such as first responder groups and/or Federal Law Enforcement Training Center (FLETC), identifying both commonalities and differentiating factors in an effort to develop a training capability that is generalizable

NEED

Ruggedization of current system is necessary to collect required physiological signals within extreme physical environments expected to be encountered during naval firefighting trainees. These added specifications are expected to enhance the data and increase the capabilities of the system.

BENEFITS

The goal of this SBIR is to develop a remote, technology enabled, anger and psychological stress treatment and management tool derived from current evidence-based interventions to help service members cope with post-deployment psychological health issues outside of the clinic and their integration into the family and community.

STATUS

This project kicked off the second week in October and has a 12 month period of performance.

PROJECT DURATION

NEW START
DEC 2017 - JUN 2018

OBJECTIVE

The purpose of this effort is to mature and incorporate stress measurement technologies by updating components of the software package into the Surface Warfare Officers School (SWOS) 0418 Advanced Team Firefighting and Damage Control course of instruction currently in development.

VALUE TO THE WARFIGHTER

To develop a remote, technology enabled, anger and psychological stress treatment and management tool derived from current evidence-based interventions to help service members cope with post-deployment psychological health issues outside of the clinic and their integration into the family and community.

FUNDING SPONSOR

Surface Warfare Officers School

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GOALS FOR FY18

- Investigate and select a plan of enhancements to basic and advanced firefighting training courses
- Modify and enhance the ruggedization of sensors and stress classifiers for extreme high heat and moisture environments

MASK-ON HYPOXIA TRAINING DEVICE

PROJECT DURATION

NOV 2013 - SEP 2020

OBJECTIVE

This project seeks to design and develop a mobile-sized hypoxia training device capable of delivering continuous pressure-on-demand airflow to an aviator's oxygen mask with varying oxygen levels simulating sea level (ambient air) to 30,000 ft.

VALUE TO THE WARFIGHTER

This project will ultimately provide the warfighter with a new mask-on hypoxia training device which will more accurately represent the true experience of hypoxia (increased fidelity). This will be achieved through pressure-on-demand capability. In addition, the system will be more compact, increasing the portability of the system into space-constrained environments.

FUNDING SPONSOR

Naval Air Systems Command
(NAVAIR)

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Packaged prototype On-Demand Hypoxia Trainer developed during Phase II efforts

DESCRIPTION

Annual hypoxia training, required for all ejection seat equipped aircraft aviators, addresses both recognition of symptoms and recovery procedures to mitigate the risks associated with hypoxia incidents that occur each year. The effort seeks to design and develop a novel training capability that address capability gaps including: 1) delivery of breathing air at a continuous 50 Liters Per Minute (LPM) increases risks of air hunger, 2) logistical impacts of compressed gases increase maintenance requirements, and 3) large footprint can impact using in high fidelity training systems.

NEED

In 2009, the NASTP Trainer Management Team (TMT) identified a need for a next-generation normobaric mask-on hypoxia trainer with enhanced capabilities, due to the lack of positive air pressure provided by existing capabilities. To date, training devices have provided a constant air pressure experience, but aviators who fly platforms that rely on oxygen masks to deliver air required to breathe are accustomed to a pressure on demand airflow through a regulator. Previous research

indicates that the constant pressure systems are a training gap.

BENEFITS

Hypoxia is a prevalent issue and is a key factor of aviation mishaps for Naval aviators. Improving training for aviators in the field of hypoxia has the potential to save not only money and time, but also lives. Increased fidelity of training will allow aviators to have a better concept of hypoxia and how to mitigate their symptoms. The increased portability of the system will also allow for more efficient and timely training.

STATUS

This SBIR has undergone competitive source selection to award Phase I, during which 4 contractors conducted feasibility analyses and designed/developed prototypes. Following evaluations of Phase I efforts, a down select award was made to 2 vendors. During Phase II efforts, contractors continued research and development with periodic demonstrations to aerospace physiologists who instruct aviation survival training. A Phase II.5 effort was awarded in FY17, which is continuing research and development to prepare for FY19 procurements.

KEY ACCOMPLISHMENTS

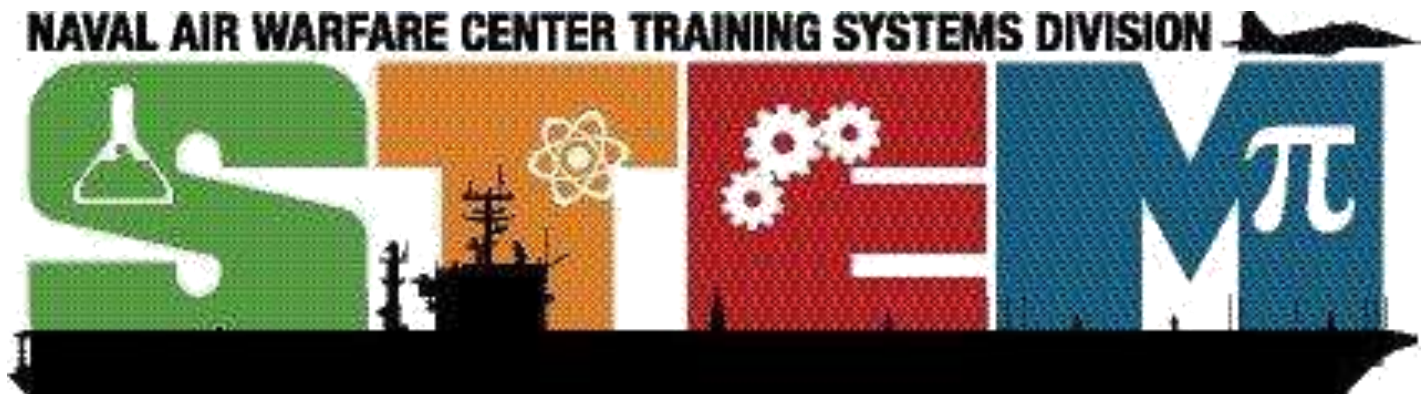
➤ Manuscripts/Publications:

- Atkinson, B. F. W., Immeker, D., Scheeler, W., McEttrick, D., & Tindall, M. (2017). A next generation hypoxia training device: Increasing fidelity to address training gaps. *Contact*, 41.
- Atkinson, B. F. W., Tindall, M., Reeh, J., Zbrank, J., Balasurbramanian, A., Marnane, J., McEttrick, D. M., Immeker, D. L., & Scheeler, W. T. (2017). Increased system fidelity for navy aviation hypoxia training. *Proceedings of the I/ITSEC*.

➤ Awards: Best poster award (2017) at the United States Naval Aeromedical Conference.

➤ Presentations:

- *A next generation hypoxia training device: Increasing fidelity to address training gaps*. (2017, January). Poster at the United States Naval Aeromedical Conference, Pensacola, FL.
- *Engineering a novel technology to increase fidelity and safety for navy aviation hypoxia training*. (2017, November). Presented at the SAFE Symposium, Orlando, FL
- Demonstration at the United States Naval Aeromedical Conference 2017 and I/ITSEC 2017.



The Naval Air Warfare Center Training Systems Division (NAWCTSD) supports Department of Defense (DoD) and Navy Science, Technology, Engineering and Mathematics (STEM) goals and priorities. Through Command and ONR funding support, the Program addresses the challenge to educate, train, recruit and retain personnel in STEM critical skill shortfall disciplines for National Security and Defense needs. The Navy's STEM Program, is built around five priorities:

1. **Inspire** the next generation of scientists and engineers (S&Es)
2. **Engage** students and build their STEM confidence and skills through hands-on learning activities that incorporate naval-relevant content
3. **Educate** students to be well prepared for employment in STEM careers that support the Navy and Marine Corps
4. **Employ**, retain and develop Naval STEM professionals, and
5. **Collaborate** across the Naval STEM enterprise, and with best practices organizations to maximize benefits to the Department.

To enhance STEM education in the Central Florida area, NAWCTSD has partnered with Orange, Seminole, and Brevard County Public Schools, the University of Central Florida, the National Center for Simulation Education and Workforce Development Committee, the Central Florida STEM Education Council (CFSEC) and its members, the Florida High Tech Corridor Council's techPATH, the Orlando Science Center, and the U.S. Naval Academy.

FLEXIBLE LEARNING ENVIRONMENT

AVIATION CLASSROOM EXPERIENCE (FLEX-ACE): READY, SET, FLY!

PROJECT DURATION

JAN 2017 - DEC 2018

OBJECTIVE

The goal of this effort is to support ONR's mission of fostering Science, Technology, Engineering, and Mathematics (STEM) education for students. Through FLEX-ACE—a USMC/ Navy-themed, aviation simulation classroom—students will be able to engage with hands-on, immersive, USMC/Navy-specific, STEM-related content. By reinforcing STEM learning through experiences that model real-world careers, we endeavor to inspire future generations to explore STEM careers—especially STEM careers within the Navy and USMC.

VALUE TO THE WARFIGHTER

Recruiting top STEM talent via a persistent “pipeline” ensures that our Warfighters will continue to be highly skilled and well-equipped. FLEX-ACE aims to attract, inspire, and cultivate exceptional STEM talent to develop the next generation of scientists, engineers, aviators, and technicians with workforce competencies that enable the USMC and U.S. Navy to continue to meet critical mission needs.

FUNDING SPONSOR

Office of Naval Research (ONR)

POINTS OF CONTACT

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Dani McNeely (PM)
danielle.mcneely@navy.mil



Above. Entrance to the Flight Lab at OSC.

Right. Inside of the Flight lab at OSC.



DESCRIPTION

The FLEX-ACE lab is a flexible aviation laboratory classroom that will offer collaborative hands-on Project Based Learning of Science, Technology, Engineering, and Mathematics (STEM) for students and visitors at the Orlando Science Center (OSC) in Orlando, Florida. The program concept uses inspirational real-world mission scenarios to teach standards-based STEM concepts and to develop critical communication, decision-making, team building, and collaborative skills. During this effort, the team will develop and implement multi-player FLEX-ACE mission scenarios and program assessment measures in order to evaluate user satisfaction and learning gains.

NEED

It is essential for the USMC and Navy to maintain recruitment of top STEM talent, as STEM fields are critical to the effective training and performance of the Warfighter. However, many adolescents lose interest in STEM early in their academic careers—sometimes as early as the 3rd grade. Thus, there is a need to provide meaningful, educational opportunities for youth to experience STEM “beyond the textbook.” It is imperative to get children engaged in STEM in interactive ways—hence, the immersive, game-based learning environment offered by FLEX-ACE.

BENEFITS

The exhibit will:

- Support the DoD and ONR's mission of fostering K-12 STEM education.
- Engage 5th-12th grade students with hands-on, immersive USMC/Navy STEM-related content experiences.
- Inspire and motivate the next generation to explore STEM careers.
- Train teachers to use and extend USMC/Navy simulation experiences to promote STEM learning in their classrooms.
- Provide opportunities for evaluation and assessment of the impact of immersive STEM programs on students and the community.

STATUS

In FY17, the exhibit space layout and graphical theming design was completed for the FLEX-ACE exhibit. Construction permits were obtained and the construction contract was also awarded. The simulation hardware and software has been solidified and we have begun mission scenario prototyping. Lastly, the team drafted the student reaction questionnaire.

GOALS FOR FY18

- Exhibit permits in place.
- Construction Contract awarded.
 - Exhibit Construction underway.
- Presented Program Progress at the Human Performance, Training, and Education Technical Review in March and September, 2017.

PROXIMAL ENGAGEMENT EDUCATIONAL RESOURCES



DESCRIPTION

PEER will deliver learning content to individual students' mobile devices allowing them to work at their own pace, and quiz them on the attained knowledge. PEER will permit the instructor to (1) control the content given to the student(s) and (2) continue on with the material without any student being left behind when they require more time. This easily modifiable immersive learning content delivery system can expose participants to STEM learning challenges in both military and non-military scenarios. Because of the ease of management and brief latency time of postings, these Orbs can be created to remain current with the latest program launches, application processes, and candidate criteria.

NEED

The PEER project will create a scalable new type of immersive STEM engagement environment for underserved population. PEER technologies allow the teachers to manage specific sites where students can view web content as Orbs on school issued mobile devices. This is accomplished by disabling the browser on the mobile devices, potentially simplifying information assurance protection e.g. lower probability of ransomware cyber attack.

BENEFITS

The PEER project will leverage technologies successfully demonstrated at I/ITSEC and expand the reach across local middle and high schools, as well as local high school and university career education centers.

The project will commence with participation in I/ITSEC STEM day, where students and educators will partake in Treasure Hunt activities to learn STEM required critical thinking in a fun game-like environment to target engaged student participation. Next the project will implement PEER pilots across the local classrooms at the selected middle and high school and university career education centers. Finally, the project will showcase composite results across all pilot programs for presentation and utilization at I/ITSEC.

STATUS

The PEER STEM learning environment will be established across six local K-12 schools and two career education centers (high school and university). The PEER pilot at I/ITSEC will serve as a replicable PEER Venue Package, which can be established and taken down for re-use across unlimited number of public events. The PEER project will strengthen the local school districts with a revolutionary STEM learning experience, while infusing STEM workforce into Navy/DoD careers.

PROJECT DURATION

NEW START
DEC 2017 - MAR 2019

OBJECTIVE

The objective of the Proximal Engagement Educational Resource (PEER) is to provide a new interactive Science, Technology, Engineering, and Mathematics (STEM) enhanced learning experiences throughout classrooms and events using Proximal Web technologies. The STEM content delivered will be developed in coordination with NAWCTSD and participating local school districts (i.e. Orange, Seminole, and Volusia), and will align with the Naval Ready Relevant Learning (RRL) construct.

VALUE TO THE WARFIGHTER

The PEER project will deliver new learning experiences to inspire, cultivate, and promote STEM education with Naval relevance on STEM S&T programs and careers. PEER's Content Management system provides an easy administrative user interface to quickly change content associated with wireless signals (ex. beacons) throughout the pilot program locations.

FUNDING SPONSOR

Office of Secretary of Defense
(OSD)

POINT OF CONTACT

Dani McNeely (PI & PM)
danielle.mcneely@navy.mil

GOALS FOR FY18

- The PEER STEM learning environment will be established across:
 - 6 local K-12 schools
 - 2 career education centers

APPENDIX A

FUNDING PROGRAM DESCRIPTIONS



Melissa Walwanis
Deputy Director &
Program Manager

The Department of the Navy's (DON) Science and Technology (S&T) program, includes Basic and Applied Research (BA1 and BA2), and Advanced Technology Development (ATD) (BA3) that is funded and managed by the Office of Naval Research (ONR). ONR is the S&T provider of the DoN and as such, is charged with providing the S&T products necessary for the operational concepts and visions for the Navy and Marine Corps of the future. The Naval S&T Strategic plan describes how ONR will enable the future operational concepts of the Navy and Marine Corps.

NAWCTSD's S&T Program primarily focuses on supporting the NAE's Naval Warrior Performance Science and Technology Objectives (STOs) that are detailed in the NAE STO document dated April 2014. The NAE STOs directly align to support the Naval S&T focus area called, Naval Warfighter Performance. Other NAE STOs addressed by the S&T project portfolio include: Strike Operations, Undersea Warfare, Information Dominance, and Enterprise and Platform Enablers.

The NAWCTSD Discovery and Invention (D&I) Program is comprised of basic and applied research. The purpose of D&I is to continuously generate new ideas. Its goals are to leverage advances in knowledge and technology, initiate investigations in areas of particular interest to the

Navy, and maintain expertise in areas that are uniquely naval in nature. Thus, the focus of the work is on fields of inquiry that are unlikely to be adequately advanced by industry or other sponsors. The program area has a long timeframe, involving extensive experimentation and demonstration before it will have an impact on operational systems.

Currently, NAWCTSD has two research projects funded under the D&I component of the Navy S&T program under the In-house Laboratory Independent Research (ILIR) Program. The first is exploring the nature of intuition with an eye toward being able to train individuals in the future to gain strategic advantage. The second project is focused on the correspondence of subjective constructs used to describe physiological symptoms of hypoxia making an important contribution to a larger portfolio of research addressing this urgent need area. Additionally, two pre-Future Naval Capabilities (FNC) program populate the portfolio. One effort focuses on performance assessment for multiteams performing in a LVC environment. The second effort focuses on integrated, cross-platform warfare for Command Teams, and System Operator training.

Continued from previous page

NAWCTSD’s ATD Program is designed to mature technology into requirements-driven, transition oriented products that support the CNO, the Commandant of the Marine Corps, and their shared vision for the service. The program is currently comprised of seven FNC projects. The focus of these programs is on multiteam systems performance assessment and training strategies, LVC technologies, adaptive training, and cyberwarfare training capabilities. Notable Speed to the Fleet accomplishments of our scientists and engineers out of this portfolio include transition of the Submarine Electronic Warfare Adaptive Trainer to Naval Submarine School and the Navy Integrated Fire Control – Counter Air Extension Trainer to the Tactical Training Group Atlantic and Tactical Training Group Pacific.

SCIENCE AND TECHNOLOGY PROGRAM INDEX

Page	Project Title	Program Type	PI/TPOC
21	Decision Making for Human-Machine Collaboration in Complex Environments	ONR - BRC	Pagan
26	Adaptive Training for USMC Close Air Support Tactics and Decision-Making	ONR, Code 30	Johnson
27	Electronic Warfare (EW) Tactical Decision Aid (TACAID)	ONR - FNC	Van Buskirk
34	Fleet Adaptive Multilevel Measurement for Operations & Unit Systems (FAM2OUS)	ONR	Pagan & Priest
36	Naval Integrated Fire Control- Counter Air (NIFC-CA X) Mission Visualization Tool	ONR	Priest
38	Accelerating the Development of Small Unit Decision Making (ADSUDM)	ONR, Code 30	Steinhauser
44	Investigation of Micro-Adaptation Schedules to Support Electronic Support Measures Operator Adaptive Training	ONR, D&I	Marraffino
45	Learning Continuum and Performance Aid (LCaPA)	ONR, Code 34	Astwood
62	Flight Deck Crew Refresher Training Expansion Packs (TEP)	ONR, TechSolutions	McNamara
69	Cyberspace Operations Degraded Exercise & Synthetic Training Architecture (CODESTAR)	ONR	Walwanis
72	Cross Domain Maritime Surveillance and Targeting (CDMaST)	DARPA	Kotick

SCIENCE AND TECHNOLOGY PROGRAM INDEX (CONT)

Page	Project Title	Program Type	PI/TPOC
74	Environment Designed to Undertake Counter A2AD Tactics Training & Experimentation (EDUCAT2E)	ONR	Walwanis
75	Fleet Training Technologies (FleeT2)	ONR	Priest
85	Distributed, Adaptive, and Modular entities for Unmanned Aerial Systems (DyAdeM)	ONR	Priest & Mercado



LCDR Rolanda Findlay
Military Deputy &
Program Manager

The Naval Innovative Science and Engineering (NISE) Program was created under Section 219 of the Duncan Hunter National Defense Act for Fiscal Year 2009. It is intended to promote and maintain the scientific vitality of Naval laboratories by funding innovative in-house research in support of military missions, the transition of technology development programs into operational use, and workforce development activities. There are three categories of NISE projects.

The Basic and Applied Research category consists of in-house research projects to explore the fundamental aspects of military relevant phenomena and determine ways in which those phenomena can best be used by the military. There are two principle objectives to such projects. First, the projects attempt to answer basic or applied research questions that are of direct military relevance. Second, the projects allow Naval laboratory personnel to grow and maintain expertise in technical areas that are of interest to the Navy.

The Workforce Development category of projects is intended more explicitly to build the capability of Naval labs through personnel training and laboratory capability development.

There are four subcategories of workforce development projects. *Training projects* allow laboratory personnel to attend special training courses that will enhance their ability to perform their assigned duties. *Higher Education projects* assist lab personnel in obtaining advanced degrees that are relevant to their Navy mission. *Strategic Rotation projects* promote the sharing of information across Navy laboratories and agencies by providing funding so that lab personnel can go on rotation to other laboratories, warfare centers, and agencies. *Strategic Growth projects* are intended to enhance laboratory core capabilities. Examples include support of strategic positions within the workforce, development of critical skill sets, or support of unfunded capability requirements.

Finally, the **Transition category** provides funding for pre-Milestone A bread board or brass board demonstrations and prototyping efforts to demonstrate critical performance parameters of key technologies. As such, it provides a vehicle by which concepts that were developed under In-House Laboratory Independent Research (ILIR), Independent Applied Research (IAR), and NISE Basic and Applied Research projects can be further matured.

2017 SECTION 219 SCIENCE AND ENGINEERING PORTFOLIO BY CORE CAPABILITY

		2016	2017	2018	2019	2020	2021	2022
CC1 - Human Systems Engineering, Integration, and Acquisition	Research, Design, and Development of Integrated Human Systems Products			A Hybrid Classification Approach using Down-Sampling Techniques and Tuned Hyper Parameters on Imbalanced Datasets			LEGEND <div>Basic and Applied Research</div> <div>Workforce Development - Strategic Growth</div> <div>Technology Transition</div> <div>Rapid Prototyping Collaborations</div>	
				Simulation Standards for Interoperability of Human Performance and Debrief Data in Training				
				Deploying Mobile Devices for Navy Training: Low Cost Mobile Device Management Alternatives				
CC2 - Optimized Human Performance and Decision Support	Human-Machine Interfaces	Identification and Definition of Unmanned Aerial System Air Vehicle Operator Performance Metrics						
				User Interface Strategies for Human-Machine Team Training in a Simulated Swarm Task				
	Human Performance Measurement and Assessment			Transition of a Crew Role-player Enabled by Automated Technologies to Maritime Patrol Training				
	Training Methodologies for Distributed Team Competencies	Basic Electronics and Electricity Learning Environment (BEETLE) II Transition						
		Evaluating Robot User Displays to Investigate Team Effectiveness (ERUDITE)						
				Investigation of Training Fidelity for Carrier Qualification and Precision Landing Modes				
	Advanced Instructional Techniques	Augmented Training for Experiential Learning for Signal Officers						
					Distributed Virtual Reality Testbed			
		Examining the Effects of Game Features on Learning Scenario Based Training						
		Investigating Low-Cost Untethered Virtual Reality Technologies and the Role of Affordances on Training Effectiveness in an Immersive Environment						
	Applied Human Behavior Modeling	Research Exploring Multi-Operator Training Environments (REMOTE)						
		Maintainer-Proficiency Model (MAIN-PM)						
CC3 - Advanced Training Systems Technology	High-Fidelity Training Environments			Exploration of Kinesthetic and Haptic Technologies in Virtual Training Environments				
				3D Interactive Aircraft Carrier Operations Planning Tool Prototype				
		Virtual Environment Motion Fidelity Model						
				Sierra Virtual Reality Helmet Display Targeting System Trainer				
		Extended Field of View (FOV) Video Aviation Training Aids						
			Spatial Augmented Reality Training Utilizing a Transparent Display					
				Transition of a Pressure On-Demand Normobaric Hypoxia Training Device for Survival Schoolhouses				
	Simulation Interoperability and Distributed LVC Technology	Integrated Warfighting Capabilities (IWC) Fidelity Investigation						
					Real-Time RF Propagation Modeling in Urban Environments for Virtual and Constructive Training			
					Scripting and Sequencing Control Components within Electromagnetic Spectrum Proficiency Modeling			
CC4 - Human Systems Analysis, Design, and Evaluation				Verification and Validation of Higher Fidelity Constructive Entities for UAS Training				
	Courseware Design			Utility and Effectiveness of Using Fleet Produced Maintenance Videos as Job Performance Aids				
	Training Optimization Analysis							
	Training Effectiveness Evaluation (TEE)							

NISE PROGRAM INDEX

Page	Project Title	Program Type	PI/TPOC
15	A Hybrid Classification Approach Using Down-Sampling Techniques and Tuned Hyperparameters on Imbalanced Datasets	BAR	Lerma
16	Deploying Mobile Devices for Navy Training: Low-Cost Mobile Device Management Alternatives	WD	Legan
17	Simulation Standards for Interoperability of Human Performance and Debrief Data in Training	WD	Tindall
22	Identification and Definition of Unmanned Aerial System Air Vehicle Operator (AVO) Performance Metrics	BAR	Findlay
23	Impact of Low-Cost Haptic Cueing on User Performance and Workload	ILIR	Mercado,
25	User Interface Strategies for Human-Machine Team Training in a Simulated Swarm Task	BAR	Guest
28	Measuring Intuition and its Relationship to Somatic Markers and Individual Differences	ILIR	Steinhauser
31	Transition of Crew Role-player Enabled by Automated Technologies to Maritime Patrol Training	TT	Killilea & Severe-Valsaint
32	Basic Electronics and Electricity Learning Environment (BEETLE) II Transition	TT	Ouakil
33	Evaluating Robot User Displays to Investigate Team Effectiveness (ERUDITE)	BAR	Guest
35	Investigation of Training Fidelity for Carrier Qualification and Precision Landing Modes	BAR	Priest

NISE PROGRAM INDEX

39	Augmented Training for Experiential Learning For Landing Signal Officers	BAR	Priest
41	Distributed Virtual Reality Testbed	WD	Peterson
42	Examining the Effects of Game Features on Learning in Scenario-based Training	BAR	Landsberg
43	Investigating Low-cost Untethered Virtual Reality Technologies And The Role of Affordances On Training Effectiveness In An Immersive Environment	BAR	McNamara
48	Research Exploring Multi Operator Training Environments (REMOTE)	WD	Astwood
50	Systematic Team Assessment of Readiness Training (START) Applied to Medicine: Medic/Corpsman Proficiency Model (MED-PM)	DHA – JPC1	Fowlkes & Riddle
52	Maintainer-Proficiency Model (MAIN-PM)	BAR	Fowlkes
54	3D Interactive Aircraft Carrier Operations Training Tool	TT	McNamara
60	Exploration of Kinesthetic and Haptic Technologies in Virtual Training Environments	WD	Peterson
61	Extended Field of View (FOV) Video Aviation Training Aids	BAR	Phillips & Prasad
66	Spatial Augmented Reality Training Utilizing a Transparent Display	WD	Cosgrove
67	Transition of a Pressure On-Demand Normobaric Hypoxia Training Device for Survival Schoolhouses	TT	Atkinson
68	Virtual Environment Motion Fidelity Model	BAR	Graniela

NISE PROGRAM INDEX (CONT)

Page	Project Title	Program Type	PI/TPOC
76	Integrated Warfighting Capabilities (IWC) Fidelity Investigation	BAR	Pagan
79	Real-time RF Propagation Modeling in Urban Environments	BAR	Richie
80	Scripting and Sequencing Control Components within Electromagnetic Spectrum Proficiency Modeling	RPC	Richie
81	Verification and Validation of Higher Fidelity Constructive Entities for UAS Training	BAR	Mercado _A
83	Utility and Effectiveness of Using Fleet Produced Maintenance Videos as Job Performance Aids	BAR	Guest
84	Medical Training Validation 2 (MTV2)	DHA-JPC1	Riddle
89	Construct Correspondence of Physiological and Subjective Measures of Hypoxia	ILIR	Tindall



John Hodak
Program Manager

The Small Business Innovation Research (SBIR) & Small Business Technology Transition Research (STTR) programs differ only in the fact that small companies perform exploratory R&D in partnership with universities and larger nonprofit research institutions in the latter program and by themselves in the former. They share the same goals:

- Stimulate naval training technological innovations,
- Strengthen the role of small business in meeting government R&D needs,
- Foster and encourage participation by minority and disadvantaged persons in technological innovation, and
- Increase the commercial application of DoD-supported research or R&D results.

The **SBIR & STTR programs** are divided into three phases. Phase I is to determine the scientific or technical merit and the feasibility of new and innovative ideas. This will typically be a six-month exploratory effort. Successful completion is a prerequisite for funding in Phase II.

Phase II awards are based on the results from Phase I and on the scientific and technical merit of a more comprehensive Phase II proposal. This second phase is the principal R&D effort. Companies are asked to consider the commercial possibilities of the proposed R&D, and encouraged to obtain a private commitment for follow-on funding to pursue their commercial potential. Phase II periods generally do

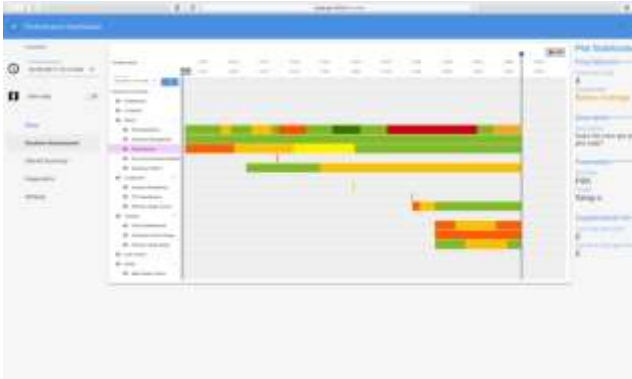
not exceed 24 months. Phase II is expected to produce a well-defined deliverable, such as a prototype or process that the Navy is interested in acquiring.

Phase III requires the use of non-SBIR/STTR capital by the small business to pursue commercial applications of the R&D and to deliver products to the Navy. This third phase is designed, in part, to provide incentives for converting DoD-funded R&D innovations to the public and private sectors. The Phase III summaries are described in the Transition Research Section.

Sources of SBIR/STTR funding include the Office of the Secretary of Defense (OSD), Office of Naval Research (ONR), the Naval Air Systems Command (NAVAIR), the Army SBIR programs, and the Joint Strike Fighter (JSF) program.

HIGHLIGHTED EFFORTS IN THE TRANSITION RESEARCH | SBIR | STTR PROGRAMS

Post Mission Assessment for Tactical Training and Trend Analysis (PMATT-TA) N08-T004

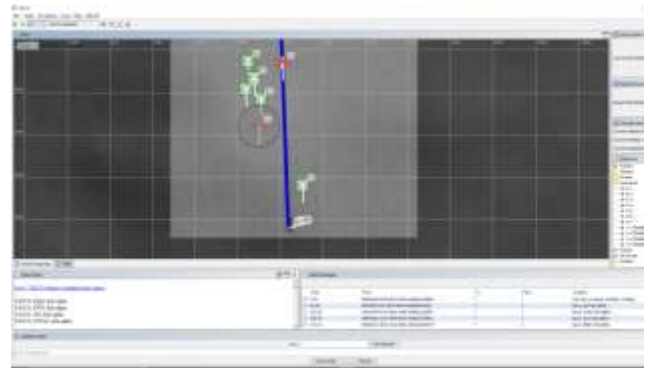


The government PMATT-TA team was recognized with the 2016 Admiral Luis de Florez Training & Simulation Team Award. The nomination specifically highlighted both the initial fleet transition of the web-based application currently in use, as well as the continued integration and implementation efforts underway to provide enhanced capabilities within the P-8 simulators for automated performance assessment and greater automation for simulator event completion. The effort has received funding from sponsors including the PMA-205 Air Warfare Training Development (AWTD), PMA-290, NAVAIR SBIR/STTR, the Office of Naval Research Rapid Innovation Funds (RIF) program, and the Section 219 the Naval Innovative Science and Engineering program.



Crew Role-player Enabled by Automated Technology Enhancements (CREATE) N142-090

A demonstration was conducted to the Next Generation Threat System (NGTS) development and management team on 22 FEB 2017 at NAS Patuxent River, MD. The effort showcases the speech capability development being conducted under a Phase II to determine the feasibility of integrating the technology with semi-automated forces in NGTS to enhance the capability to meet requirements like virtual wingman for F-18 platform training.



Mask-On Hypoxia Training Device SBIR N132-093

This effort has completed human subjects testing. The research effort provides an opportunity to evaluate the system's ability to produce hypoxia symptoms for comparison of historical data of symptoms experienced when using alternative training systems, as well as whether the system reduces or eliminates the existing air hunger issue experienced on the Reduced Oxygen Breathing Device 2 (ROBD2). Recently this effort has received additional funding to finalize the system design for procurement in FY18.

TRANSITION RESEARCH PROGRAMS INDEX (CONT)

Page	Project Title	Program Type	PI/TPOC
20	Adaptive Training System for Maintaining Attention during Unmanned Aerial Systems (UAS) Operations	SBIR	Bowens
29	Methods for Actionable Measures of Absolute Cognitive Workload	SBIR	Mercado,
30	Techniques to Adjust Computational Trends Involving Changing Data (TACTIC-D)	STTR	Tindall
40	Complex-Knowledge Visualization Tool	STTR	Fowlkes & Riddle
46	Mishap Awareness Scenarios and Training for Operational Readiness Responses	SBIR	Warnham
47	Post Mission Assessment for Tactical Training & Trend Analysis (PMATT-TA)	AWTD; STTR; 219TT	Atkinson
51	Team-based Advanced Resilience Accelerator (TARA)	AWTD	Steinhauser
55	Course Rules Part Task Trainer Study	AWTD	Priest
57	Dynamic Flight Simulation as a Supplement to In-Flight Pilot Training	SBIR	Priest
58	Effective Measures of Training Display System Performance	SBIR	Graniela
59	End-User Speech Recognition Support Tools for Crew Resource Management Training Systems	STTR	Killilea

TRANSITION RESEARCH PROGRAMS INDEX

Page	Project Title	Program Type	PI/TPOC
63	Immersive Parachute Descent Procedure, Malfunction and Decision-Making Training System	SBIR	Atkinson
64	Innovative Collimated Displays	SBIR	Graniela
65	Small Projector Array Display System	SBIR	Riner
70	Crew Role-player Enabled by Automated Technology Enhancements (CREATE)	SBIR	Killilea
71	Distributed Synthetic Environment Correlation Architecture and Metrics	SBIR	Graniela
73	Distributed Training Network Guard (DTNG)	AWTD JSF	Lobel
78	Network Effects Emulation System (NE2S)	AWTD	Ennis
86	Effectiveness Assessments of Mixed & Immersive Reality for Aviation Training	SBIR	Mercado,
91	Mask-on Hypoxia Training Device	SBIR	Atkinson



Lisa Ouakil
Program Manager

The NAWCTSD Technology Transfer Program operates under the auspices of the Federal Technology Transfer Act, related laws, executive orders, directives and guidance. The anticipated benefits of sharing the results of Navy modeling, simulation, training, and human performance research and development (R&D) with public and private research organizations are: improved national, state and local training and education, new commercial products and additional national employment opportunities, access to federal government subject matter experts and resources, and feedback on R&D products that can be used to improve future government systems.

Federal technology transfer has been in place since 1980 to facilitate the transfer of federally developed technologies to the private sector as well as academic institutions and state & local governments. Federal and non-federal partners have the opportunity to work together on mutually beneficial research and development using instruments called Cooperative Research and Development Agreements or CRADAs. Technology transfer legislation also promotes the licensing of inventions/patented technologies developed in the federal laboratories for commercial applications.

Through technology transfer, the nation's investment in federal research and development leads to products, services, and capabilities for the good of the public.

The objective of the NAWCTSD Technology Transfer Program is to increase the development of partnerships with both the public and private sectors in order to share the cost, development, and application of technologies, and to foster development of commercial sources for NAWCTSD technologies/innovations. This is accomplished through technology transfer vehicles such as CRADAs, Commercial Services Agreements, Licensing Agreements, and Education Partnership Agreements with academia, industry, and state and local governments. Agreements such as CRADAs can provide a vehicle for NAWCTSD to receive feedback on, and to further develop, R&D products, which can be used to improve future systems. NAWCTSD also partners with other federal government agencies through Interagency Agreements.

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There are benefits to the public from the exchange of knowledge and products within the government. Exchange includes sharing information and products with other federal agencies, as well as with state and local governments. By sharing knowledge and products on a wide basis, the public reaps the benefits from research conducted for one purpose or agency in many new ways. The return on the investment of the tax dollar is increased.

Another benefit of Federal Technology Transfer legislation has been the establishment of the Federal Laboratory Consortium (FLC). This consortium is a network of more than 700 federal laboratories and research centers. The FLC provides a nationwide laboratory forum to develop strategies and opportunities for linking federal laboratory technologies and expertise with the marketplace. NAWCTSD is a voting member of the FLC.

The technologies/products/services described in this Technology Transfer section offer opportunities for partnerships with NAWCTSD through CRADAs or licensing agreements. For more information, please send an email to: [ORLO Orlando Tech Transfer@navy.mil](mailto:ORLO.Orlando.Tech.Transfer@navy.mil).

TECHNOLOGY TRANSFER PROGRAM

Page	Project Title	Program Type	PI/TPOC
24	Unmanned Systems - Training Experimentation & Simulations (US-TES) Laboratory	CIP	Slage
37	Squad Overmatch (SOvM)/ Team Overmatch (TOvM)	DHA/MRMC	Milham
49	Sexual Assault Prevention and Response (SAPR) Virtual Immersive Training	DON, SAPR	Steinhauser
56	Defense Health Agency (DHA) Total Learning Architecture (TLA) Learning Technology Roadmap with Concept Pilots	DHA J9	Gusse & Welch
77	Modular Advanced Technologies Marksmanship Proficiency	MARCOR SYSCOM	Adams
90	Firefighting Trainer Modification and Enhancement	SWOS	Pharmer

CAPITAL INVESTMENT PROGRAM



Ron Wolff
Program Manager

As the principal Navy center for research, development, test and evaluation, acquisition and product support activity for training systems, the laboratories at NAWCTSD provide a vital capability to ensure that we deliver the latest products and services to the fleet that are rooted in the science-of-learning. NAWCTSD's laboratory environments allow our scientists and engineers to perform the latest in research and development and accelerate the state-of-the-art for a broad spectrum of customers and warfare areas.

NAWCTSD was approved for two investment projects that ended in FY16, with more on the horizon. The two projects were (1) an interoperability toolset for automating test compliance with the Navy Continuous Training Environment and (2) an Unmanned Systems – Training Experimentation & Simulation (US-TES) Laboratory. Together, these and future investment projects will keep NAWCTSD at the forefront of the R&D community associated with delivering the latest modeling, simulation, training and education products to the fleet.

Since FY12, the **NAWCAD Capital Investment Program (CIP)** has become instrumental in ensuring that NAWCTSD laboratory capabilities will be well positioned to address future warfighting needs. As a working capital funded organization, NAWCTSD competes yearly for CIP funds to enhance our laboratory capabilities. CIP is funded by depreciation of prior acquired assets and are included in the labor rates charged to direct customers.

SCIENCE, TECHNOLOGY, ENGINEERING AND MATHEMATICS (STEM) EDUCATIONAL OUTREACH



Dani McNeely
STEM Site Assistant Coordinator

The Naval Air Warfare Center Training Systems Division (NAWCTSD) has a long-standing connection to the academic community within the central Florida community, reflected in its 29-year partnership with Blankner School (K-8) in Orange County, where NAWCTSD has provided mentors, laboratory tours, job-shadow opportunities, and incentives for students. NAWCTSD also has a well-established relationship with the University of Central Florida (UCF), providing internship opportunities for UCF students.

These efforts have evolved into STEM outreach to area schools, where NAWCTSD partners its Scientists & Engineers (S&Es) with teachers in classrooms, offers opportunities for professional development of science and math teachers, and involves students in STEM-related activities. Due in part to these efforts and those of many other central Florida stakeholders, the visibility of STEM is rising in central Florida.

NAVY LOCAL IMPACT AT A GLANCE

STEM Program Launched	2009
Geographic Reach	<ul style="list-style-type: none"> • Brevard County • Lake County • Orange County • Osceola County • Seminole County • Volusia County
FY 17 S&E Mentors & Coaches	<ul style="list-style-type: none"> • 2 part-time site coordinators • 104 S&Es • 12 mentors (robotics and Blankner)
FY 17 Schools Reached	<ul style="list-style-type: none"> • 2 K-8 schools • 12 elementary schools • 25 middle schools • 8 high schools • Total: 47 schools in 6 school districts
FY 17 Personal Interactions	<ul style="list-style-type: none"> • 216 teachers • 7,516 students
Other Partners & Catalysts	<ul style="list-style-type: none"> • University of Central Florida • University of West Florida • University of South Florida • National Center for Simulation • Central Florida STEM Education Council • Florida High Tech Corridor • Orlando Science Center

HIGHLIGHTED STEM OUTREACH EVENTS

FIRST Robotics

In 2017 NAWCTSD sponsored 5 FLL teams and 5 FTC teams through the OSD DoD STEM robotics grant program. Each of the teams were connected with a NAWCTSD Mentor. An exciting highlight of the 2017 competition year was the story of the Hagerty High School FTC team.

On April 18, 2017, 15 students from Hagerty High School Robotics Team 4717, The Mechromancers, traveled to Houston, TX to compete at the FIRST World Championship with their one-of-kind robot, Woodrow T. Bot, AKA Tim Burr.

They played 9 qualifying matches Wednesday-Friday and finished in 23rd place. However, top ranked teams were lobbying for them to join their alliance for the Jemison Division Semi-Finals. Early Saturday morning, Team 9915, Robo Thunder (ranked 2nd in division) from Bellvue, WA invited them to join their alliance. They also invited Team 7203 KNO3 from Tampa, FL to form their 3 team alliance. They would play in the Minute Maid field, a first for the FIRST program.

The 3-team alliance won the semifinals, making them the Jemison Division Winning Alliance. They advanced to the finals to play against the Winning Alliance from the Franklin Division Saturday night. It was an exciting finals, to say the least. Both alliances tied 1-1 after two matches. In a nail biting final match to claim the World Championship title, the team put up an impressive offensive fight to the very end. **They are 2nd (Finalist Alliance Award) in the WORLD!**

Palmetto Cyber Defense Competition (PCDC)

The Palmetto Cyber Defense Competition (PCDC) was a three-day cyber defense competition held by the Space and Naval Warfare Systems Center Atlantic in collaboration with the South Carolina Lowcountry Chapter of the Armed Forces Communications and Electronics Association (AFCEA). This competition was intended to energize local high schools and colleges to invigorate focused curriculum development for the type of technical skills that are needed in today's fast paced and challenging cyber environment.

SeaPerch

NAWCTSD has coordinated training of NAWCTSD S&Es with teachers and trainers from Seminole and Orange County Public Schools, the Girl Scouts, Boys and Girls Clubs of Central Florida, the Orlando Science Center (OSC), and the YMCA. As a result of this training, SeaPerch clubs have been formed in Seminole & Orange County Public Schools; the OSC continues to offer SeaPerch summer camp sessions, the Army PEO STRI continues to use SeaPerch in its summer intern program, and the YMCA uses the SeaPerch activity in its after school programs.



SeaPerch Regional at Daytona State



Palmetto Cyber Defense Competition in SC

HIGHLIGHTED STEM OUTREACH EVENTS

Science Olympiads



Science Olympiad competitions are like academic track meets. Each year, a portion of the events are rotated to reflect the ever-changing nature of genetics, earth science, chemistry, anatomy, physics, geology, mechanical engineering and technology. By combining events from all disciplines, Science Olympiad encourages a wide cross-section of students to get involved. Emphasis is placed on active, hands-on group participation. Through Science Olympiad, students, teachers, parents, principals and business leaders bond together and work toward a shared goal.

In 2017, NAWCTSD S&Es assisted with several events at the Florida State Science Olympiad and the Elementary Science Olympiad both held at the University of Central Florida. S&Es have also supported Science Olympiads in previous years.

Project Based Learning (PBL) Teacher Training

In November 2016, NAWCTSD teamed with CFSEC, Army, and American Society of Civil Engineers to provide training to 75 teachers from six surrounding counties at I/ITSEC. The curriculum taught was based off of the material learned at the U.S. Naval Academy. NAWCTSD and USNA also supported a booth dedicated to PBL activities in the STEM Pavilion.



STEM Clubs

In FY17, NAWCTSD S&Es assisted teachers with robotics programs in middle schools and high schools in Orange, Seminole and Brevard counties. S&Es also organized and ran a Math Club at Deerwood Elementary School in Orange County and tutored students in the Norfolk, Virginia area.

Teach-ins

American Education Week, held in November of each year, is a national celebration of public education. NAWCTSD S&Es participated in this event by taking part in Teach-Ins at area schools. The S&Es speak about their careers in STEM fields, NAWCTSD, and the Navy in general. The responses from the schools and students are overwhelmingly positive, and our S&Es continue to return year after year.

stemCONNECT

Virtual engagement to reach kids across the state via a web application. SMEs are given the opportunity to interact with students near and far. They're able to answer students' questions directly and give them insight into their careers.

Making Robotics Fun for Middle Schoolers

Four day workshop meant to introduce teachers to robotics and inform them on how to set-up and maintain a robotics program at their school. The first two days cover topics for beginning teachers, and the second two days cover extended topics.



Teacher Robotics Training at Milwee Middle

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NAWCTSD LABS

LAB	MISSION
Acoustic Training & Simulation Lab (ATaS)	Provide current sensor and acoustic data used in modeling and simulation across Navy Anti-Submarine Warfare training devices.
Basic & Applied Training & Technologies for Learning & Evaluation (BATTLE):	Conduct cognitive science, behavioral research, & training evaluations to improve training & human performance in a variety of learning environments. Capabilities include: Instructional Strategies research, Advanced Training/Instructional Technology R&D
Concept Development & Integration Lab (CDIL)	Research and prototype development of interoperable live, virtual and constructive training devices and technologies, and provide smart buyer awareness to training system acquisition programs.
Interoperability, Engineering & Application (IDEA) Lab	<p>Provide simulation interoperability tools and technical expertise in support of joint, live, virtual, constructive programs and related research, development, and acquisition efforts.</p> <p><u>Technology Integration Facility (TIF) (AKA Dome Room):</u> Provide Visual Systems analysis, system integration and Command demonstrations.</p>
Live, Virtual & Constructive Modeling & Simulation (LVCMS) Lab	Research and development integration of Anti-Submarine Warfare (ASW) Training Systems and to develop and deliver ASW training prototypes for the warfighter.
Science for Training Evaluation, Analysis, Learning and Theory (STEALTH) Lab	To facilitate basic and applied research utilizing state-of-the-art training and human performance solutions that enhance the operational readiness of the nation's warfighters in complex multi-team systems and environments

Multipurpose Reconfigurable Training System 3D®

**Multipurpose Reconfigurable Training System 3D and MRTS 3D are registered trademarks of the U.S. Navy*

Design, integration, and lifecycle support of the MRTS 3D® classroom and MRTS 3D laboratory and their associated software applications; including: maintaining software baseline repositories and testing MRTS 3D products. Fielded MRTS 3D products include simulations for VIRGINIA Torpedo Room, VIRGINIA Emergency Diesel Generator, and Mobile Electric Power Plant (MEPP). Numerous additional products are in development.

The lab also provides lifecycle support for the Integrated Undersea Surveillance System (IUSS) TL-29 and ICP synthetic acoustic analysis trainers, as well as legacy MRTS products such as the Submarine Communications Support System (SCSS) Trainer, Common Submarine Radio Room (CSRR) Trainer, Weapons Launch Council Team Trainer (WLCTT), and AN/BLQ-10 Maintenance Trainer.

Navigation Lab (NavLab)

Provide software development, integration, test and post deployment support of Submarine Piloting and Navigation training systems and Virtual Environment for Submarine Shiphandling (21H35).

Rapid Design, Development, and Fabrication Lab (RD2F)

Provide rapid response 'Speed to Fleet' and research and development capabilities for advanced concept demonstration and prototyping, customization, and low rate production of advanced training technologies. Utilizes cutting edge technologies including 3D immersive and game engines, virtual and mixed reality, speech recognition, adaptive training, automated machining, and additive manufacturing to create innovative training products, reduce acquisition program risk, extend legacy system life-cycles, and further the science of learning.

Simulation & Training Research to Improve Knowledge & Effectiveness (STRIKE) Lab

Provide cognitive and behavioral research for improving training and human performance. Investigate and advance the use of technologies for support in embedded, distributed, and distance learning applications.

Submarine Research Application Team (SubRAT)

Develop adaptive training research test beds and prototypes. Develop configurable networked navigation workstation simulations (for individual and team training) and instructor exercise authoring, control, and debrief capabilities. Explore (via section 219 and development projects) emerging technologies (e.g., AR, VR, haptic, mobile) for application to training requirements. Additionally, execute research and development of virtual tours (e.g., photo-based, 3D modeled, mobile) for familiarization and procedural training.

Trident Training System (TTS) Lab

Provide primary simulation and training support to the Trident Ballistic Missile Submarine force. Also provide simulation and training support for other UNDERSEA assets.

Virtual Technology Development Operations Center (VTDOC)

Provide technology development and operations center for distributed simulation and training exercises.

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**“SPECIAL THANKS TO ALL OF OUR
PRINCIPAL INVESTIGATORS AND RESEARCHERS**
*for their technical excellence and innovative contributions
to improving the capability, quality, and cost-effectiveness
of the training technologies provided to the Fleet.”*

--Robert Seltzer,
Director of Research and Technology Programs



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